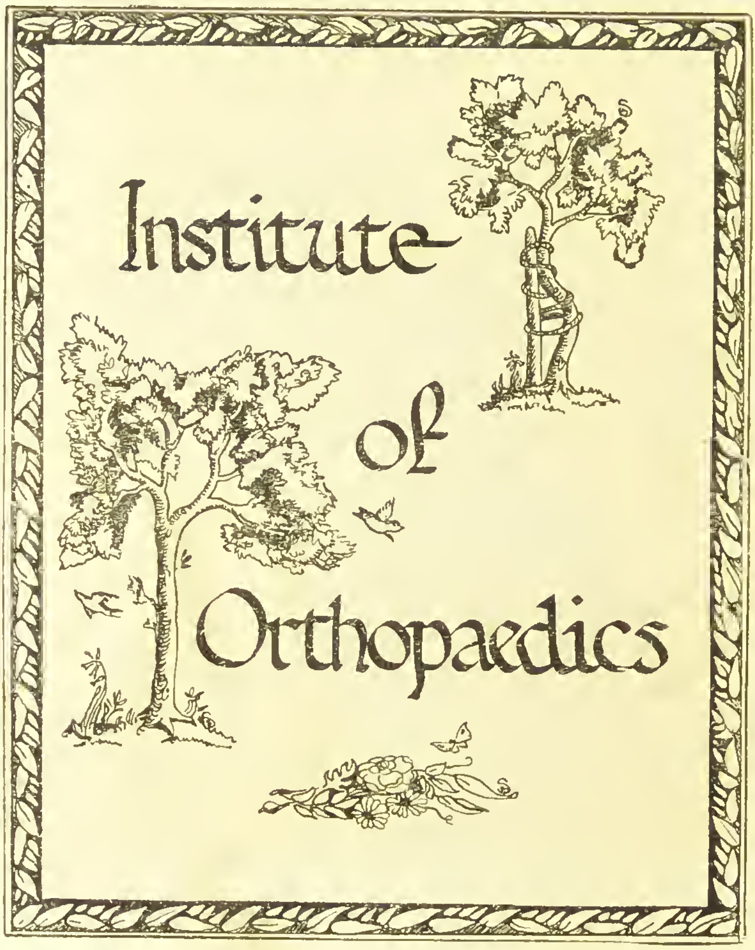

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ORTHOPÆDIC SURGERY

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Edmund Owen
Oct 9th 1881

A TREATISE

ON

ORTHOPÆDIC SURGERY

BY

J. WARRINGTON HAWARD, F.R.C.S.

SURGEON TO ST GEORGE'S HOSPITAL

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PREFACE.

It is questionable how far Surgery has benefited by the state of division in which it is now the custom to practise it; for while it cannot be doubted that our knowledge of some diseases, and still more of some operations, has been greatly advanced in consequence of the special attention which has been by some devoted to them; yet, on the other hand, it seems no less certain that an exclusive devotion to one part of Surgery is apt to interfere with a just appreciation of the proportion which that part bears to the whole, and to lead to its being regarded with a harmfully restricted view.

Without discussing the vexed question of specialism, I will venture to express the opinion that there is no good reason for the separate practice of Orthopædic Surgery; although in hospitals it may be convenient for the purpose of teaching, and for the division of labour, to make a separate department for this branch of Surgery.

One disadvantage of the separation which Orthopædic Surgery has to some extent undergone, seems to be that the average student as a rule knows very little about it ; and whilst in charge of this department at St. George's Hospital, I have been surprised at the frequency with which I have been asked by students to refer them to some work from which its details might be learned.

While deprecating therefore the separate practice of Orthopædic Surgery, its separate teaching may, I think, be not only justified, but desired ; because such separation permits the more elaborate consideration and explanation of minutiæ, without which it cannot be thoroughly understood.

If, then, I have entered in this book somewhat more than is usual into details, it is because it has seemed to me that success in Orthopædic Surgery depends so greatly upon accurate attention to details ; and because it is just in such details that most of the books with which I am acquainted have seemed to be deficient.

I have treated the subject not as a special mystery, but as a part of general surgery, based upon the same principles, only to be rightly learned in connection with the rest, and herein considered by itself only as a matter of convenience.

In some parts of the book, and especially in the section upon lateral curvature of the spine, I shall be found at variance with some of the recognised authorities ; for my experience has driven me to the conclusion that much harm has been done by the too mechanical view which has by some been taken of these affections. But although I have been obliged to differ with these writers on some points, the references in the text will show that I have not been unappreciative of the value of their investigations, nor have I neglected to acknowledge my obligations to them in other directions.

I do not suppose my own work to be free from errors, which an increased knowledge may correct; yet I have done my best to be accurate, and have at least been careful to make no assertions which I have not myself verified, or given sufficient authority for.

Whatever faults the book may contain, I shall not plead in their excuse that they are due to haste in its execution (which would be admitting, as Bishop Butler says, having come abroad in a disorder which one ought to be ashamed to find oneself in at home), but must confess that they are due to accident, incapacity, or want of knowledge—a confession which may perhaps incline the reader to regard them with the less intolerance.

16 Savile Row:
June, 1881.

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ORTHOPÆDIC SURGERY.

CHAPTER I.

TALIPES, OR CLUB-FOOT.

Talipes, or club-foot.

Definition

The term talipes, or club-foot, is used to denote certain kinds of distortion of the foot due to muscular contraction. Such contractions may have their origin in a paralysis, by which the muscular equilibrium of the limb is disturbed; or in a condition of spasm, due probably to disturbance of the nervous system; or more rarely, to changes in the affected muscles.

Varieties of talipes.

The varieties of talipes are usually distinguished by their anatomical characters, and have the following names:

1. *Talipes varus*: in which there is inversion of the foot, the inner margin being raised, and the heel more or less elevated.
2. *Talipes valgus*: in which the foot is everted, the outer margin being raised, and the arch flattened.
3. *Talipes equinus*: in which the heel is raised.
4. *Talipes calcaneus*: in which the heel is depressed.

Various combinations of these typical forms are also met with. Thus cases of Talipes equinus, in which the heel is considerably raised, and the inversion of the foot but slight, are called *equino-varus*, and those in which there is eversion of the foot *equino-valgus.*

Similarly, the addition to Talipes calcaneus of inversion or eversion of the foot, gives to such cases the name of *Talipes calcaneo-varus* or *calcaneo-valgus.*

Talipes may be either congenital or may be acquired at any period after birth. The non-congenital is the larger class, and some varieties are but rarely met with as congenital affections. Although anatomically cases of congenital and non-congenital talipes may be scarcely distinguishable, it is necessary clinically to separate the two classes, because, as will be presently shown, the prognosis, and in many respects the treatment, will be very different. I shall consider first congenital talipes.

Congenital talipes.

All the varieties of talipes described above may occur as congenital deformities; but cases of congenital Talipes equinus are extremely rare.

Talipes varus.

1. *Talipes varus.*—This is the most common form of congenital talipes, and is met with in every degree of severity. In a well-marked case, of which fig. 1 is an illustration, the appearance of the foot is as follows. The toes are inverted and the inner margin of the foot is raised so that the sole looks backwards, and the outer margin is the lowest part of the foot. These changes are due chiefly to shortening of the tibialis anticus and tibialis posticus muscles. There is more or less extension of the foot at the ankle-joint, owing to the shortening of the muscles ending in the tendo Achillis and the consequent raising of the heel. The prominences of the heel and of the inner malleolus are to a great extent obliterated;

while the tarsal bones project unduly on the dorsal aspect of the foot, which has a forward direction. The sole is somewhat shortened by the lateral flexion of the foot, and sometimes by the contraction of the plantar fascia and muscles.

Morbid anatomy of bones;

An examination of the skeleton of such a foot reveals certain changes in the shape and position of the bones.[1] The os calcis, by the elevation of the tuberosity, is drawn from the horizontal into a more or less vertical position ; it is also somewhat rotated on its vertical axis, so that its anterior extremity is directed inwards, and its posterior extremity outwards and towards the fibula.

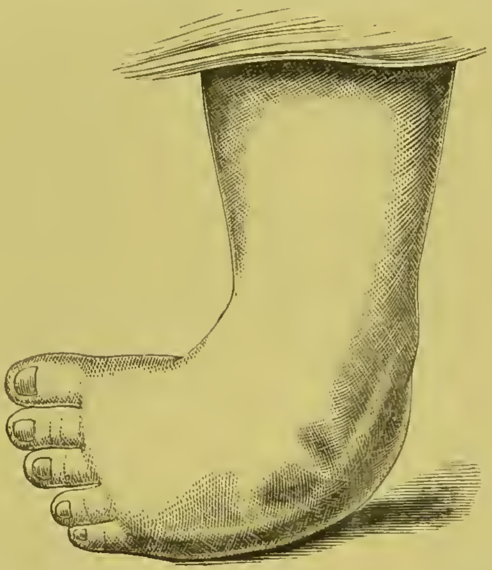

Fig. 1.—An example of talipes varus of moderate severity.

From a model in the museum of St. George's Hospital.

The cuboid bone maintains its connection to the os calcis, and follows the inward direction of the anterior extremity of that bone. The astragalus does not partake of this rotation on its vertical axis, but follows the os calcis in its rotation forwards on its horizontal axis, so that only the posterior portion of its superior articular surface is in contact with the inferior articular surface of the tibia, and the anterior part of its articular facet projects beneath the skin

---

[1] The morbid anatomy of talipes has been especially elucidated by the careful researches of Mr. William Adams ; for an account of which, as well as of his investigations into the reparative process in divided tendons, I would refer the reader to Mr. Adams' *Jacksonian Prize Essay*, published by Churchill, 2nd ed., 1873.

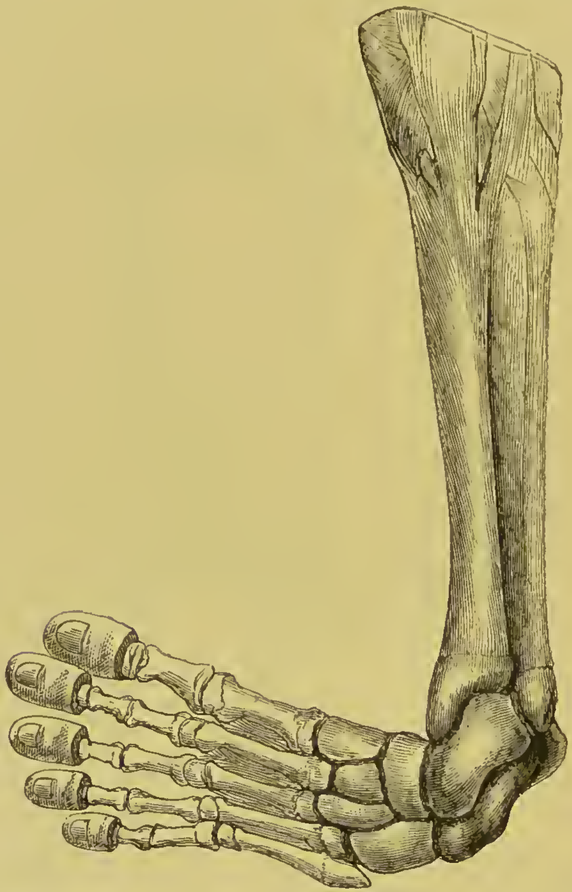

FIG. 2.—DISSECTION SHOWING THE ALTERATIONS IN THE FORM AND POSITION OF THE BONES IN TALIPES VARUS.

From a specimen in the museum of St. George's Hospital.

on the dorsum of the foot. Besides this displacement the shape of the bone is materially altered by the twisting inwards of its head and neck, so that the anterior articular surface looks inwards instead of forwards. The scaphoid bone carrying with it the cuneiform bones is drawn inwards and upwards towards the inner malleolus, the metatarsal bones retaining their relation to the tarsal, and thus following their displacement inwards.

It will thus be seen that the distortion in Talipes varus is of two kinds; namely, a movement of extension which takes place at the ankle-joint, and a movement of inversion which takes place chiefly at the transverse tarsal joint.

Fig. 2 is drawn from a dissection of the foot of a newly born infant affected with Talipes varus, which I made for the purpose of showing the alterations in the bones which are described above.

of ligaments;

The condition of the ligaments varies greatly in different cases of Talipes varus. In many of the slighter there is but little alteration in these structures, but in some of the severer their shortened condition opposes a serious obstacle to the cure of the deformity. In such cases not only are the plantar ligaments contracted, but also the internal lateral and the posterior ligaments. The anterior portion of the internal lateral ligament, which passes from the malleolus to the scaphoid bone, occasionally offers great resistance to the eversion of the foot, as Mr. Adams has shown by dissection. The difficulty of the treatment will be very much in proportion to the shortening of the ligaments; and this is to be estimated not by the amount of deformity, but by the degree of rigidity which is felt on endeavouring to draw the foot towards the natural position.

of muscles;

As a rule the muscles in Talipes varus do not present at birth any alteration of structure, though they may be rather less developed than in the natural limb. In a few rare cases, however, there may be an imperfect development or even absence of some of the anterior muscles of the leg, together with extensive fatty degeneration of the muscular structure.[1]

of tendons; It is important, however, in operating on these

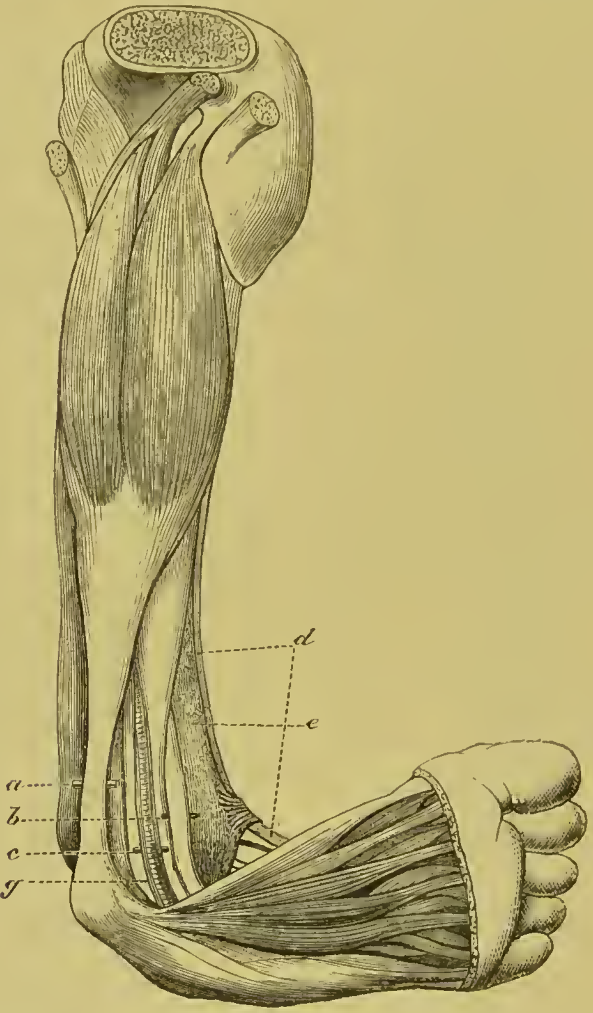

FIG. 3.—AN EXAMPLE OF CONGENITAL TALIPES VARUS.

Dissected to show the relative position of the tendons and vessels at the posterior and inner aspect of the foot. From a specimen in the museum of St. George's Hospital.

a. Bristle passed under the tendon of Achilles.
b. Bristle passed under the tendon of the Tibialis posticus muscle.
c. Bristle beneath the posterior tibial vessels.
d. The Tibialis anticus muscle and tendon.
e. The tibia.
g. The posterior tibial nerve.

---

[1] See Mr. Adams' description of such a case in *Trans. of the Pathol. Society*, vol. iii. p. 468.

cases to remember that the tendons are considerably displaced from their normal situations.

The tendons in front of the ankle-joint are much nearer its inner side than in the normal foot, and that of the Tibialis anticus muscle (fig. 3, *d*) is found passing over the inner malleolus and across the angle made by that bone with the great toe.

The tendon of the Tibialis posticus muscle (fig. 3, *b*) occupies its usual situation close behind the termination of the inner border of the tibia, but is rather more forward on the inner aspect of the leg, and at a greater distance than is natural from the tendo Achillis, owing to the rotation of the tuberosity of the os calcis towards the fibula ; it will be found, as Dr. Little has pointed out, 'exactly midway between the anterior and posterior borders of the leg on its inner aspect.'

The rotation of the os calcis on its vertical axis, by which its tuberosity is brought towards the outer malleolus, necessarily involves a corresponding deviation of the tendo Achillis (fig. 3, *a*), which is placed nearer to the fibula than in the natural foot.

of vessels and nerves

The vessels and nerves of course follow the general distortion of the foot, but are not altered in their relations to the tendons with which they are naturally in contact.

The description given above applies to a case of varus of average kind and severity ; but in practice we meet not only with every degree of the deformity as a whole, but also with great variations in the extent to which its different factors predominate.

Varieties of Talipes varus.

Thus it is not uncommon to see cases in which the inversion of the foot can be almost overcome by gentle traction, the chief contraction being of the calf muscles.

In others the plantar fascia, or the internal lateral ligament, offers the principal resistance, while in very severe cases all the characters described may be exaggerated; the inversion being so great that the great toe may touch the inner side of the leg.

Uncured Talipes varus.

Moreover, if the congenital deformity is allowed to remain uncured, further changes take place in consequence of the weight of the body being borne upon the distorted foot. The child walks upon the outer border of the foot, which gradually becomes folded backwards (fig. 4) until the weight is borne upon the dorsum of the foot. The bones become altered in shape, and still more displaced as time goes on: the os calcis and astragalus assume a nearly vertical position, the upper surface of the latter becoming to a greater extent protruded on to the dorsum; the scaphoid is drawn up under the inner malleolus, the cuboid bone following the displacement inwards, and being also turned downwards so that its dorsal surface is towards the ground.

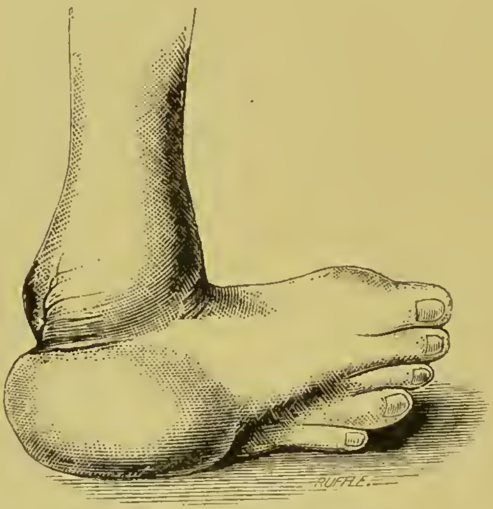

FIG. 4.—AN EXAMPLE OF TALIPES VARUS IN THE ADULT.

The drawing has been made while the dorsal surface of the foot is lifted so as to show the cushion which has formed over the part subjected to pressure. From a model in the museum of St. George's Hospital.

The skin over the dorsum, which has to bear the superincumbent weight of the body, becomes greatly thickened and indurated, a large corn forms, and between this and the tarsal bones a bursa is developed (fig. 4).

Although, in the adult with uncured varus, this provision of nature is a material assistance to progression, it is often also a source of much trouble from the occurrence of inflammation of the bursa beneath the corn.

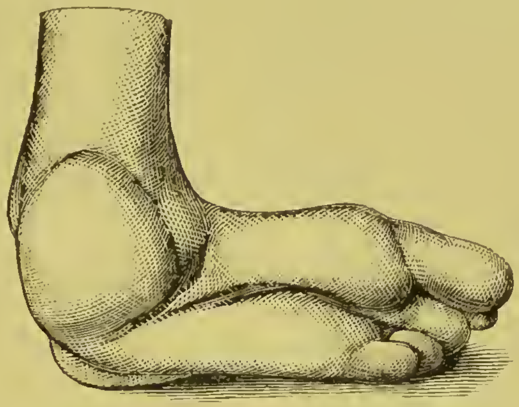

FIG. 5.—AN EXAMPLE OF TALIPES VARUS IN THE ADULT.

Drawing showing the plantar aspect of the foot represented in the preceding figure.

The gait in such cases is, of course, very awkward, the inversion of the feet necessitating the careful lifting of each foot when it is advanced, to prevent its entanglement with the foot of the other side.

Talipes valgus.

Talipes valgus.—This is one of the rarer forms of congenital talipes. The foot is flattened and everted, its anterior part is more or less flexed and rotated outwards, the outer border of the foot is raised, and there is usually some amount of elevation of the heel (fig. 6). The distortion is due to contraction of the peronei, and in many cases of the ex-

Morbid anatomy.

tensor longus digitorum, and the gastrocnemius. The shape of the bones is not altered, and their relative positions undergo much less change than in Talipes varus.

In proportion to the shortening of the muscles of the calf there is, of course, an elevation of the tuberosity of the os calcis, and a corresponding tilting forwards of the astragalus. The cuboid and scaphoid bones are rotated outwards, and their outer borders raised, so that the inner part of the articular surface of the head of the astragalus is left uncovered by the scaphoid. The cuneiform bones and with them the bones of the metatarsus are also rotated outwards, the outer ones being raised; and there is a variable amount of flexion of the metatarsus. In severe cases, therefore, in which the os calcis is elevated and the metatarsus flexed, the sole of the foot assumes a convex, instead of a concave form, and these changes must involve a corresponding elongation of the plantar ligaments. If the deformity is not remedied it becomes exaggerated with the lapse of time and by

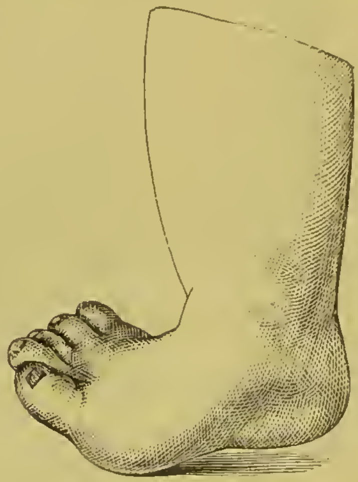

FIG. 6.—AN EXAMPLE OF CONGENITAL TALIPES VALGUS.

From a model in the museum of St. George's Hospital.

use of the feet; but although it may give rise to much pain and lameness, no great changes in the bones result.

Talipes equinus.

Talipes equinus.—This form of talipes is extremely rare as a congenital affection, though very common among non-congenital deformities. It is, however, occasionally met with at birth, and Dr. Little[1] states that cases of congenital Talipes equinus which have undergone no treatment remain as cases of simple equinus throughout life, without any eversion or inversion of the foot taking place. The deformity consists simply of elevation of the heel, due to contraction of the muscles of the calf. The foot is extended and the person walks upon the distal extremities of the metatarsal bones (fig. 7).

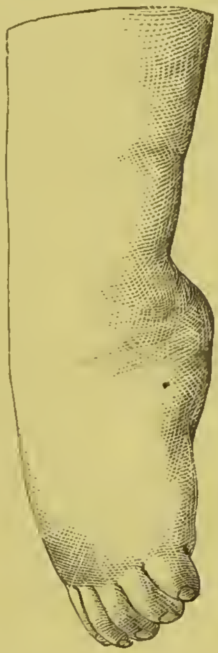

Fig. 7.—An example of congenital talipes equinus.

From a model in the museum of St. George's Hospital.

Morbid anatomy.

The bones are not altered in shape; there is a variable amount of elevation of the tuberosity of the os calcis, and tilting forwards of the astragalus ; the tarsal and metatarsal bones assuming a more or less vertical position. If the foot is used for walking, the forward curve of the tarsus becomes increased, and the phalanges bent to a right angle with the metatarsal bones. There is severe lameness, which is aggravated by the formation of troublesome corns on that part of the skin of the sole which covers the ends of the metatarsal bones. In this condition the dorsal ligaments of the foot are necessarily elongated, while the plantar and posterior ligaments are shortened. There is no material alteration in the position of the tendons.

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[1] Holmes' *System of Surgery*, vol. iii. p. 684, 2nd ed.

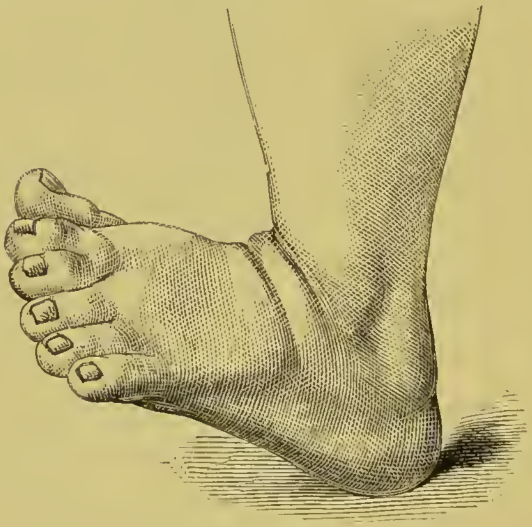

FIG. 8.—AN EXAMPLE OF CONGENITAL TALIPES CALCANEUS.

The foot has also an extra toe. From a model in the museum of St. George's Hospital.

Talipes calcaneus.

Talipes calcaneus.—This is the reverse of Talipes equinus, and consists of a depression of the os calcis with flexion of the foot at the ankle-joint (fig. 8).

Morbid anatomy.

As a rule in congenital cases there is but little rigidity of the contracted muscles (the flexors of the foot), nor are any structural alterations found in the bones and ligaments. The deformity is therefore easily remediable, and tends rather to diminish than to increase by the use of the foot.

Talipes equino-varus.

Talipes equino-varus.—It has already been shown that in congenital Talipes varus there is always some amount of elevation in the heel, so that the deformity ought more strictly to be called *Talipes equino-varus*. This name is, however, usually applied to cases in which the elevation of the heel is the marked characteristic of the distortion, but in which there is also some slight amount of inversion of the foot.

Talipes equino-valgus.

Talipes equino-valgus.—So, again, in most cases of congenital Talipes valgus the heel is somewhat raised, but when this is a marked feature the deformity is called *equino-valgus*.

Talipes calcaneo-varus and calcaneo-valgus.

Talipes calcaneo-varus and *calcaneo-valgus* are the names applied to cases in which the chief divergence from the normal position of the foot is the depression of the heel, which is combined, however, with some amount of inversion or eversion of the foot.

Causes of congenital talipes.

Of the *causes of congenital club-foot* but little is known, but probability and analogy seem to indicate its origin in some abnormal condition of the nervous centres, which results in the spasmodic contraction and shortening of the muscles concerned in producing the deformity.

Talipes is often hereditary and has been seen as early as the third month of utero-gestation,[1] but whether it is capable of being produced by shocks or other disturbance of the nervous system of the mother during pregnancy is doubtful. Although talipes is not uncommonly associated with other deformities, especially with spina bifida, yet children affected only with club-foot are frequently well developed and otherwise quite healthy.

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[1] Adams, *Club-foot*, 2nd ed. p. 215: Churchill, London, 1873.

Prognosis.

The prognosis in uncomplicated cases is favourable, for by appropriate treatment the deformity may be completely remedied, and a perfectly useful foot may usually be obtained.

Treatment.

The treatment of congenital talipes is based upon certain general principles the details of which must be modified in adaptation to each particular instance.

I shall first therefore describe fully the treatment of the typical form of the deformity—Talipes varus—and then, to save repetition, point out what modifications of this treatment are requisite for the other varieties of talipes.

There are chiefly three things to be attained in the treatment of congenital talipes: first, the elongation of the shortened structures; second, the overcoming of the distortion caused thereby; third, the promotion of the nutrition and function of the limb. Each of these is of importance, and the neglect of any one of them will interfere with the success of the treatment.

Treatment of Talipes varus.

In very slight degrees of Talipes varus, when the foot can be easily drawn into the natural position, and there is an absence of rigidity about its tissues, no operative treatment is needed. A light metal splint (see fig. 11) should be applied so as to keep the foot in the natural position; and this should be removed two or three times a day for manipulation and friction of the foot. The manipulation must be systematically directed to the exercise and stretching of the shortened muscles, and the splint should be worn until all tendency to relapse is overcome. When, however, the distortion cannot be thus easily overcome—that is to say, when the shortening of the muscles, ligaments, or fasciæ is sufficient to prevent the foot being brought into a natural position by a moderate amount of traction with the hand—then the subcutaneous division of the contracted structures should be the first step in the treatment. The operation of subcutaneous tenotomy, foreshadowed by Hunter, recommended by Delpech, and successfully practised by Stromeyer, has more than anything else conduced to the successful treatment of congenital talipes, and has greatly advanced the surgery of many other deformities. Before the invention of this operation talipes remained an almost incurable distortion, but now there are few surgical affections the treatment of which is more eminently satisfactory.

Subcutaneous tenotomy.

The operation for the subcutaneous division of tendons and other structures is based upon the important observation of Hunter, that subcutaneous wounds seldom inflame, while those open to the air commonly both inflame and suppurate. Sir James Paget recites an experiment illustrating the difference in the case of a divided tendon: 'In the same rabbit, the tibialis anticus and extensor longus digitorum were divided on the right side with a section through the skin; on the left, with a subcutaneous section through a small opening. Twelve days afterwards the rabbit was killed. The wound on the left side was well repaired, and with comparatively little trace of inflammation; the gap on the right was closed in with a scab and an imperfect scar, but under these was a large collection of pus, and no trace of a reparative process.'[1]

Operation of subcutaneous tenotomy.

The division of the tendon should therefore be effected in such a manner that as little injury as possible is done to the neighbouring parts; the puncture of the skin should be very small, the wound should be immediately closed, and every care taken to ensure union by first intention.

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[1] *Lectures on Surgical Pathology,* 2nd ed. p. 129.

For this purpose a knife with a narrow but strong blade should be used, such as is represented in fig. 9. The blade should be passed beneath the tendon with its flat surface towards it, and at such a degree of obliquity that when the handle is depressed and the cutting edge turned towards the tendon, a considerable leverage is obtained at the point of the knife. The tendon is then divided from within outwards, the finger being placed upon the superjacent skin to feel for the approach of the knife. The moment the division of the tendon is felt to be complete, the edge of the knife should be turned away from the skin, and the blade withdrawn in the same position in which it was introduced. The finger which had been placed over the tendon is pressed upon the wound as the knife is withdrawn, so as to keep the puncture closed until a small pad of lint has been secured over it with a strip of adhesive plaster. The foot and leg should then be bandaged, and a splint applied so as to keep the part at rest; finally, the limb should be enveloped in a warm soft stocking. During the operation an assistant should hold the limb—the leg in one hand, the foot in the other; when the operator is introducing the knife the foot should be held in such a position as to relax the tendon; but when the cutting edge is applied the tendon should be made tense by moderate traction upon the foot, which should be relaxed as soon as the tenotomy is complete. In the healthy subject the operation is not usually followed by any constitutional disturbance, and by only so

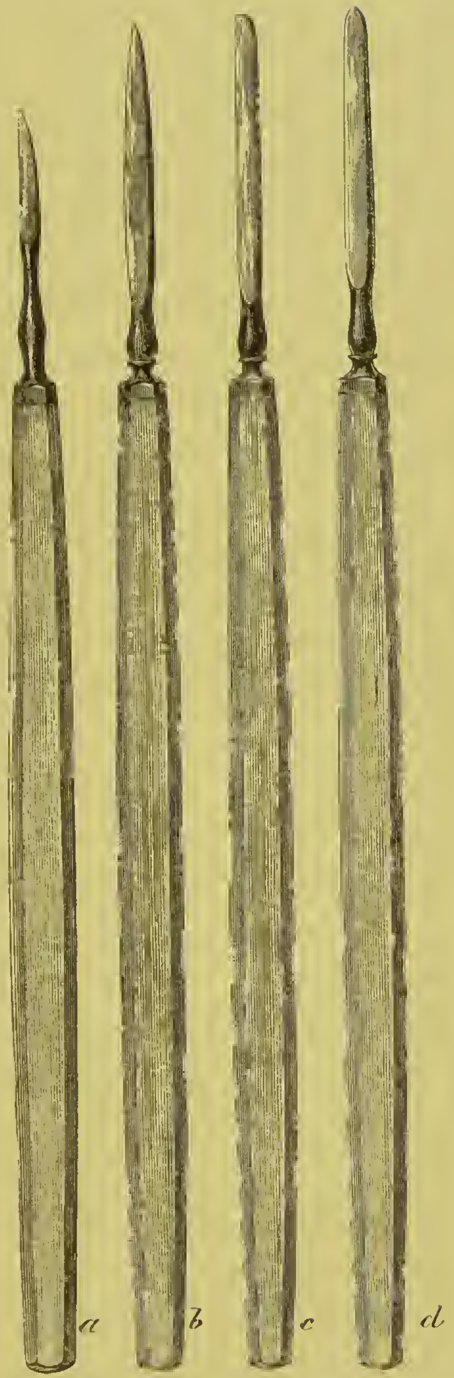

FIG. 9.—KNIVES FOR THE DIVISION OF TENDONS AND FASCIÆ.

a. Knife for dividing contracted bands of palmar fascia.
b. Ordinary sharp-pointed tenotome.
c. Blunt-pointed tenotome, such as is used for dividing the posterior tibial tendon.
d. Angle-pointed tenotome.

much local action as is necessary for the repair of the divided tendon.

Repair of divided tendons.

The reparative process in divided tendons has been made the subject of numerous investigations since Hunter's original experiments thereupon in the year 1767, and has more recently been studied with much care by Mr. W. Adams,[1] whose account of it is based upon dissections of divided tendons in the human subject as well as in animals.

When a tendon is divided, the cut ends are separated to a variable extent, depending upon the contractility of the muscle to which it belongs, upon the position in which the limb is placed, and upon the surrounding attachments of the tendon.

Extending between the ends of the tendon is its tubular sheath of connective tissue, and it is this which chiefly furnishes the reparative material. The sheath becomes vascular and succulent, and after the absorption of any blood that may have been effused within it, the interval between the divided ends of the tendon becomes filled with lymph, which gradually becomes fibrillated and forms a firm bond of union between them. The new material so closely resembles the old tendon, and is so intimately blended with it, that after a time it would be difficult to distinguish between them, except for a certain translucency which is possessed by the former, and which is not natural to the latter.

By this means the divided tendon is increased in length to the extent of the interval by which its ends are separated. This separation should not be maintained at its full extent at once, lest the uniting medium be thin and weak, but should be gradually produced by altering the position of the limb. For the first few days after the tenotomy therefore, the limb should be retained nearly in the same position as before the operation; the separation of the ends of the tendon being slowly increased by the mechanical means adopted to remedy the distortion. The time occupied in obtaining the required elongation will vary, according to the activity of repair and the severity of the case, from two to six weeks.

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[1] *On the Reparative Process in Human Tendons*, by W. Adams: Churchill, London, 1860.

Results of tenotomy.

If the operation and after-treatment be carried out with ordinary care and skill in a healthy subject, a perfectly useful muscle of the normal length is obtained; for the tenotomy not only does not impair the strength of the muscle, but often leads to an improvement in its nutrition, by the increased activity which is subsequently obtained.

It is true that some few adhesions may, and doubtless often do, form between the divided tendon and the surrounding structures; but in ordinary cases they are not of the least consequence, for they give way to manipulation or use of the foot, and do not in any perceptible manner interfere with the function of the muscle.

To attempt to cure club-foot without tenotomy because of the supposed, and as I believe imaginary, evils of tendon-cutting is a retrogression, which is as unscientific in principle as it is unsuccessful in practice.

For the cure of Talipes varus the tendons usually requiring division are the tibialis anticus, the tibialis posticus, and the tendo Achillis. Section of the plantar fascia is also frequently necessary.

Age for

The operation is of so slight a character that it operation.

may be safely undertaken early in infancy, and in slight cases all the tendons may be divided at the same sitting. The exact age selected for the operation must of course depend somewhat upon the health and nutrition of the child; for if the infant be very thin and ill-nourished, the skin so easily suffers from even slight pressure, that it is better to wait until careful feeding, and, if necessary, cod-liver oil or other aids have produced an improved condition of nutrition. But except for such reasons delay in commencing the treatment is undesirable, because the longer the deformity remains uncured, the greater are the difficulties of the treatment. With the persistence of the distortion, the contracted tissues become more resistent and the alteration in the shape of the parts more pronounced; moreover, when dentition commences the child is much less tolerant of the needful apparatus, and is much more liable to febrile disturbance, rashes upon the skin, and other infantile diseases, which would materially interfere with the treatment. In a healthy and well-nourished infant I therefore advise the operation to be performed between the second and third month.

In cases operated upon after the period of infancy, and in all those in which the inversion of the foot is at all considerable or resistent, even in infants, the treatment should be divided into two parts; the first to overcome the inversion, the second to remedy the elevation of the heel. The anterior and posterior tibial tendons, and if necessary the plantar fascia, are to be divided at the first operation, and the division of the tendon of Achilles postponed until the inversion of the foot and the contraction of the sole have been overcome. Dr. Little, who first recommended this method, has pointed out that by leaving the tendo Achillis uncut during the first part of the treatment, the os calcis remains a fixed point from whence the anterior part of the foot can be acted upon.

Primary operation.

The primary operation should be performed in the following manner :

Division of posterior tibial tendon.

The posterior tibial tendon should be the first divided. The child being placed upon its back upon a firm table, the leg and foot are held by an assistant standing at the side. The operator sits in front of the patient when dividing the left tendon, and on the left side when operating upon the right tendon. The foot should then be abducted so as, if possible, to make the tendon sufficiently prominent to be felt just above the inner malleolus. In a fat child, however, the tendon can seldom be defined, and then the posterior border of the inner malleolus will be the guide ; or if this cannot be made out, the puncture must be made, as Dr. Little recommends, 'exactly midway between the anterior and posterior borders of the leg upon its inner aspect, about a finger's breadth above the lower end of the inner malleolus.'

The sheath of the tendon must first be opened with the sharp-pointed knife (fig. 9, *b*), the blade of which with its flat surface held parallel to the border of the tibia is thrust down by the side of the bone to the sheath of the tendon, which is opened by a slight movement of the point. The knife is then withdrawn and the blunt-pointed knife (fig. 9, *c*) is inserted through the same puncture and passed between the tibia and the tendon. To make sure that the blade is behind the tendon the resistent bone should be felt on one side and the elastic tendon on the other side of the blade. The cutting edge should then be turned towards the tendon, which should be made tense by eversion of the foot, and thus divided, more by the tension of the tendon against the knife, than by any movement of its blade.

As soon as the knife is felt to have passed through the entire thickness of the tendon, its edge should be turned away from the skin, and the blade withdrawn in the same position in which it entered ; a pad of lint and strip of plaster being immediately placed over the puncture. In severe cases the tendon of the flexor longus digitorum should be divided together with that of the tibialis posticus, indeed, from the close proximity of these tendons, it is in many instances difficult to avoid making the section of both at once.

Division of flexor longus digitorum tendon.

Should the posterior tibial artery be by accident divided, a jet of blood will follow the withdrawal of the knife. The hæmorrhage, however, will be controlled by a pad and bandage, and I have never seen any harm result, although of course every care should be taken to limit the movement of the knife so as to avoid a wound of this vessel.

Division of tibialis anticus tendon.

The tendon of the tibialis anticus muscle should be next divided. The tendon can be easily felt at the inner side of the front of the ankle joint, and should be divided at that situation by passing a sharp-pointed knife (fig. 9, *b*) beneath the tendon from without inwards, and cutting towards the surface, care being taken to turn the edge of the knife away from the skin and to relax the foot, the moment that the tendon is cut through.

Division of plantar fascia.

The plantar fascia may be next divided, and if this is necessary its section should be made by passing the sharp-pointed tenotome beneath its deep surface from the inner border of the sole, and cutting towards the skin in the same manner as for the division of a tendon.

Mechanical treatment.

The division of the tendons and fascia having been made in the manner described, and each puncture immediately closed by lint and plaster, the foot and leg are next bandaged with a flannel bandage, and secured to a flexible splint with the limb in the same position as before the operation. The parts are left thus until the fourth day, when, the foot being uncovered and the plaster removed, it will be found, if all has gone well, that the punctures are healed.

The treatment must now be directed to overcoming the inversion of the foot, by bandaging it to a straight metal splint applied to the outer side of the leg and projecting below the foot. The limb should be first dusted with starch powder and covered with a flannel bandage as far as the knee, then secured to the splint by carrying the bandage down the leg as far as the ankle; lastly, the foot should be gently drawn towards the splint by the remaining turns of the bandage, which should extend to a little short of the ends of the toes. The bandage should be stitched to the edge of the splint, which should be removed and re-applied every day for the first week, and every second day afterwards; the toes being left uncovered that the condition of the circulation may be observed and a too tight bandage made evident. To avoid harmful pressure the lower end of the splint should be bent outwards as the foot approaches the straight line.

Second operation.

In two or three weeks the inversion will have been remedied, and the tendo Achillis is then to be divided.

Division of tendo Achillis.

The operation is thus performed. The patient is placed in the prone position, the foot projecting over the edge of the table in front of which the surgeon sits.

The sharp-pointed tenotome (fig. 9, *b*) is passed beneath the tendon from its outer side, and with a sufficient degree of obliquity to obtain a leverage at its point when the handle is depressed. The edge then being turned towards the tendon, an assistant puts the tendon on the stretch by flexing the foot, when a very little pressure is sufficient to effect the division. The knife is then instantly turned with its edge away from the skin, and the foot at the same time returned to the position of extension, for if these precautions are not observed immediately that the tendon is cut through, the skin over it may be also divided. Lint and plaster are applied and the foot bandaged to the splint as before, and retained thus for four days. On the fourth day all is to be removed, the foot powdered and bandaged, and then placed in an apparatus by means of which the foot is gradually to be flexed, and the elongation of the tendo Achillis effected. For this purpose it is usual to employ some such modification of Scarpa's shoe as is represented at fig. 10.

Mechanical treatment.

Use of Scarpa's shoe.

The chief points to be attended to in the use of this instrument, are :

1. That the shoe and the straps which secure the foot in it are to be well and softly padded.

2. That the instrument is to be adapted to the foot, by bringing the shoe to an inclination to the leg-iron correspondent to that of the foot to the leg.

3. That great care is to be taken to keep the heel well down into the space made for it, and this is done

chiefly by the strap which passes across the front of the ankle and through the hole for the heel. The band seen near the front of the shoe is to keep the anterior part of the foot everted.

4. That the instrument should be frequently removed and re-applied, so that any excessive pressure may be at once detected and avoided.

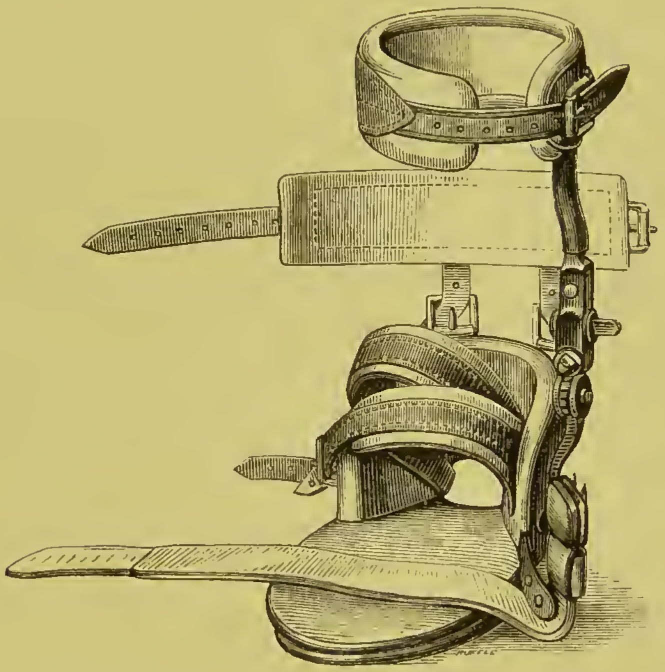

FIG. 10.—MODIFIED SCARPA'S SHOE, FOR THE TREATMENT OF TALIPES EQUINO-VARUS.

The flexion of the foot is produced by a cog-wheel at the ankle. A second cog-wheel is seen, by which a little increased eversion may be given to the foot.

5. That the flexion of the foot should be produced very gradually, and by daily very slight movement of the cog-wheel for the purpose.

In two or three weeks the foot will thus have been flexed to rather less than a right angle; and now another part of the treatment should commence. Up to this point two of the three processes[1] which I have shown to be necessary for the cure of club-foot have been completed. The shortened structures have been elongated and the distortion overcome. It remains to carry out the third part of the treatment; namely, that for the promotion of the nutrition and function of the limb.

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[1] See p. 14.

Third division of treatment.

I would especially insist upon the importance of this last, because it is this portion of the treatment which is most apt to be neglected, and to the inefficient performance of which are due most of the relapses. However skilfully the operative and mechanical treatment above described may have been executed, the result will certainly fall far short of complete success, unless those measures are followed by a long course of systematic exercise of the weak muscles, and by precautions against a recurrence of the deformity.

For this purpose passive movements and friction should be applied to the limb regularly twice a-day, and great care should be taken to keep the limb thoroughly warm by appropriate clothing. The leg and foot should first be gently rubbed with flannel for a few minutes; and then the leg being held with one hand, the foot is grasped with the other and repeatedly carried through the movements of eversion, flexion, or any others which have been restrained or prevented by the previous deformity.

The apparatus used for the correction of the distortion should still be applied at night, and a soft boot with a light outside iron jointed at the ankle, worn during the day. The cold douche, briefly applied and followed by friction, is an useful aid to the promotion of the nutrition of the muscles; and children who are old enough should be taught systematic exercise of the weak muscles, such as hopping on one leg, pushing at a stirrup attached to an elastic band, and others of the same kind, which the ingenuity of the surgeon will devise for the particular needs of each case. But whatever of this kind is done must be practised systematically, regularly, and for a considerable period; the parents being made to understand that this part of the treatment is as important as that which has preceded it. Its duration must of course depend upon the severity of the case, but it may give an approximate idea of what is necessary, to say that as many months should be devoted to the third portion of the treatment, as there have been weeks occupied in the first and second.

Treatment of relapsed and neglected talipes.

In relapsed cases, and those which do not come under treatment until after the patient has walked, each part of the process will require a much longer time than that which has been mentioned as usual for the cases seen in infancy, and the result is as a rule less satisfactory.

For the cure of these, more complicated instruments are often necessary, and for the unfolding of the foot I know of none better than that invented by Mr. William Adams. This instrument consists of metal troughs for the thigh and leg, with a free hinge-joint corresponding to the knee; to the outer side of the leg trough is attached a metal rod, in which is inserted a cog-wheel at points corresponding to the transverse tarsal and the tarso-metatarsal joints. This rod is applied by means of straps and an oblique sole-plate to the outer side of the foot, and by the movements of its sections the anterior part of the foot is everted and uplifted. A bent lever is also fixed to the heel, and acts from a point corresponding to the ankle-joint, so as to produce flexion of the whole foot.

In some cases (chiefly those which are neglected during infancy) there is a tendency, after the deformity of the foot has been remedied, to an inversion of the limb during walking. This is due to perverted muscular action, and necessitates the wearing of a metal support extending to the pelvis. On the outer side of the limb a light iron rod should be fixed below to the sole of the boot, and above to a band which encircles the waist. On the inner side the iron should extend from the sole to the middle of the thigh. The irons should be jointed at points corresponding to the hip, knee, and ankle.

Removal of tarsal bones.

It is not now common to see cases of congenital talipes which have been allowed to remain without treatment till adult life. Such cases are, however, occasionally met with, and from the long use of the foot in its distorted condition, they are usually of a very intractable kind. For these, and also for such other relapsed and severe cases as have proved irremediable by tenotomy and the ordinary methods, operations have been practised which have for their aim the cure of the deformity, by the removal of so much of the tarsal bones as will allow of the restoration of the natural position of the foot. It is hardly necessary to point out that this method of treatment is based upon an entirely different principle to that which has been previously described, and that it must of necessity result in a certain amount of deformity, although this may be of a kind which is much less detrimental than that for which it is substituted. The treatment of which I have hitherto spoken is directed to bringing the displaced bones of the foot into their natural relative positions by the gradual use of mechanical appliances; and only such of the tendons or fasciæ are divided, as by their contracted condition would prevent this alteration of position being accomplished. The method now to be described involves a much greater division of tendons and other soft parts, as well as the permanent loss of some of the bones; so that, although the foot is at once brought into an improved position, it cannot be expected to possess its complete functional activity. I do not say this in disparagement of the operation, but to prevent misconception of its method, and to show that it should be limited to those cases for which the treatment by tenotomy is unsuited, or has proved inefficient.

Operation for excision of tarsal bones.

Dr. Little in his work on club-foot[1] suggested the excision of the cuboid bone in intractable cases of varus, an operation which was practised by Mr. Solly in 1857, and more recently in several cases by Mr. Davy. But the excision of the cuboid bone leaves a less satisfactory foot than the removal of a complete wedge of the tarsal bones, after the manner practised by Mr. Davies-Colley, and described by him in a paper published in the 'Medico-Chirurgical Transactions' for 1877.[2] The operation may be thus performed: an Esmarch's bandage having been applied, an incision is made along the outer border of the foot, from the middle of the os calcis to the middle of the fifth metatarsal bone. This is joined at right angles by another across the dorsum of the foot. The soft parts being reflected, the cuboid bone is first removed, then a wedge-shaped portion of the tarsus is excised, of sufficient size to allow the foot to be brought into a good position without much force. The wedge of bone, which may be removed with the chisel or saw, should have its base of a width correspondent to that of the cuboid, and should be rather thicker above than at its lower surface. The foot is then at once brought into position, the drainage of the wound provided for, and an appropriate splint applied. The operation, though a severe one, has yielded very good results.

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[1] *Treatise on the Nature of Club-foot*, by W. J. Little, M.D.: London, 1839, p. 305.

[2] *Trans. of the Medico-Chirurgical Soc.*, vol. lx. p. 11. A case of resection of the tarsal bones for double congenital Talipes equino-varus, by J. N. C. Davies-Colley, F.R.C.S.

Having now described in detail the methods of treating the typical form of congenital club-foot, it will only be necessary to point out in what manner these require modification for the cure of the other varieties of the deformity. The principles and methods will be the same, the details will be altered in adaptation to the various distortions.

Treatment of Talipes valgus.

Well-marked Talipes valgus is not common as a congenital deformity, but a slight degree of eversion of the foot is met with in a considerable number of infants. If there is no muscular rigidity, these are easily curable by passive movements and the application of a splint to the inner side of the leg and foot.

In more severe cases it is needful to divide subcutaneously the peronei tendons, and sometimes the tendo Achillis, which a reference to fig. 6 will show to be the muscles chiefly concerned in the production of the deformity. Occasionally the extensor longus digitorum also requires division. When the heel is raised it is better, as in varus, to defer the division of the tendo Achillis until after the eversion of the foot has been overcome.

Division of peronei tendons.

The tendons of the peroneus longus and brevis are divided by passing the sharp-pointed tenotome (fig. 9, *b*) between the tendons and the fibula a little above the external malleolus; the edge of the knife is then turned towards the tendon, and the foot adducted by an assistant, when a slight movement of the knife will effect the division. The extensor longus digitorum and peroneus tertius are divided in front of the ankle-joint, by passing the same tenotome beneath the tendons from their inner border, and cutting towards the skin surface while the tarsus is extended. The pad and strapping having been applied over the puncture, the foot and leg are bandaged and a splint applied to keep the part at rest. After a few days, the eversion of the foot is to be overcome by bandaging to a straight splint placed on the inner side of the leg. The foot is thus brought to the condition of Talipes equinus, when the tendo Achillis is to be divided, and the remaining deformity remedied by the use of some modification of Scarpa's shoe. A very simple apparatus answers the purpose in most cases of valgus; that which I recommend is a light metal shoe, with a single joint at the ankle, whereby it moves upon a splint of the same material adapted to the leg. The angle of the sole-plate to the leg-splint can be altered and fixed by a thumb-screw (fig. 11).

Division of extensor longus digitorum.

Mechanical treatment

Valgus splint.

The splint should be padded and covered with soft leather, and should have a valgus-pad similar to that used for flat foot[1] fixed on the inner side of the sole. The foot and leg are to be bandaged to this apparatus, which in slight cases may be applied as soon as the puncture for the tenotomy is healed, the foot being brought into position at once. This should be worn for some months after the cure of the distortion.

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[1] See p. 126.

Children who are not treated till after they have walked, should wear such a splint at night, and during the day should wear a boot such as is recommended for flat foot and described at page 126. Passive movements and systematic exercises are to be practised on the principles laid down in the section on the treatment of varus.

Treatment of Talipes equinus.

The treatment of Talipes equinus consists of the division of the tendo Achillis, and the gradual flexion of the foot at the ankle-joint by means of Scarpa's shoe, or the splint represented above. The necessary elongation of the tendon may be obtained in infants in two or three weeks. This should be followed, as in the other varieties of talipes, by passive

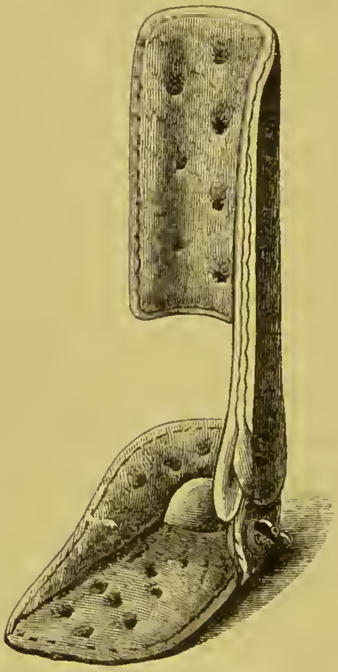

FIG. 11.—METAL SHOE, SOFTLY PADDED AND COVERED WITH LEATHER, AND WITH JOINT AT THE ANKLE.

The angle of the sole-plate to the leg-splint can be altered and fixed by a thumb-screw.

This shoe may be used for overcoming the elevation of the heel in any of the forms of talipes, and is suitable for retaining the foot in position during the later stages of treatment, and for the prevention of relapse.

A pad can be added to the sole when it is used for cases of valgus.

movements, and the application of a splint for a few months to prevent relapse. In very slight cases no tenotomy is required ; but in those not cured during infancy, section of the plantar fascia will be needed as well as of the tendon of the heel.

Treatment of Talipes calcaneus.

Talipes calcaneus rarely requires the section of any tendons, but usually yields to passive movement and the application of a splint to keep the foot in position. The simple shoe described at page 32, fig. 11, answers every requirement in the treatment of this affection. I have never had occasion to divide the flexors of the tarsus for congenital calcaneus ; and bearing in mind the tendency to the spontaneous disappearance of this deformity, I doubt whether tenotomy can ever be needed.

Treatment of compound varieties of talipes.

The treatment of the compound varieties of talipes is in every way similar to that above described for the simpler forms. Sufficient has been said above to indicate the tendons that would usually require division, and the symptoms upon which to base a judgment as to the necessity or not of operative interference.

Non-congenital talipes.

Non-congenital talipes.—All the forms of talipes which have been described as congenital affections may be simulated more or less exactly by the acquired varieties, and are therefore conveniently distinguished by the same names ; but there are many important differences between the two classes, so that the separate consideration of the non-congenital cases is necessary.

Causes of non-congenital talipes.

The most common cause of acquired talipes is infantile paralysis.

Infantile paralysis.

This is a peculiar form of paralysis which may attack children at any time between birth and puberty, but is most frequent in its occurrence during the period of the first dentition. Its onset is often accompanied by slight febrile disturbance, and occasionally by sickness or convulsions; but in many cases no illness is observed. Although, too, the attack is most prone to occur during the first dentition, it is not usually coincident with any special difficulty in the eruption of a tooth, nor is it often possible to discover for it any immediate cause. In the majority of cases the symptoms at the commencement are simply those of some slight ailment. The child is somewhat cross and restless, and perhaps a little feverish; it is put to bed, and next morning one or more limbs, or groups of muscles, are found to be paralysed. In a few cases I have seen great pain suffered in the limb before the development of the paralysis ; but usually the pain or tenderness, if any, is slight and transient, as is also the constitutional disturbance. The tendency of the disease is to more or less complete recovery; most often the greater number of the affected muscles recover their power, one group or sometimes a single muscle remaining paralysed. Several limbs may, however, be permanently disabled, and it is probable that the disease may sometimes, though rarely, prove fatal at the outset.

Morbid anatomy.

The morbid anatomy of the disease, so far as it is at present understood, shows it to be connected with inflammatory degeneration of that part of the spinal cord from whence the paralysed muscles derive their nervous supply.

There is a marked diminution in the number and size of the motor ganglion cells of the anterior cornu of the grey matter, and an atrophy of the axis-cylinders of the nerve-fibres, with increase of the connective tissue, in the antero-lateral columns.

Besides these lesions, examination of the spinal cord made at an early stage of the disease in the more acute cases, reveals hæmorrhages and other evidences of inflammation, while in cases of long duration the atrophy and sclerosis may have a much more extensive distribution.

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Effects of infantile paralysis.

The muscles which remain paralysed are soft and flabby, and soon undergo wasting and fatty degeneration; the limb becomes smaller than its fellow, its growth is retarded, and its temperature and nutrition lowered, so that much trouble is often caused by chilblains and indolent ulceration. The intellectual capacity of children thus affected is not usually altered; and this is an important distinction between the disease I have described and another class of cases met with in children, in which paralysis is combined with a variable amount of mental deficiency.

Paralysis with rigid muscles.

In the last class the affected muscles are in a state of rigidity, a much larger number of muscles is generally involved, and much greater deformity is produced than is the case in infantile paralysis. These cases are as a rule incurable, and the mental condition of the patients is generally such as to make any treatment of the deformities useless. The same may be said of the pseudo-hypertrophic paralysis of Duchenne, a disease in which at one stage the paralysis is accompanied by increased size of the limb, due to the growth of connective tissue between the muscular fibres.

Pseudo-hypertrophic paralysis.

Spasmodic talipes.

Other causes of non-congenital talipes are spasmodic muscular contractions, which may be due to (*a*) 'neuromimesis';[1] (*b*) to disease of the nervous centres; or (*c*) to peripheral irritation and reflex action.

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[1] I use Sir James Paget's word, 'neuromimesis' or 'nervous mimicry,' as a far more accurate name for this condition than 'hysteria,' by which it used formerly to be called. See *Clinical Lectures and Essays*, by Sir James Paget; edited by Howard Marsh, p. 172, 1st ed.

Neuro-mimesis.

Very severe distortions are met with in 'neuro-mimesis,' many of the forms of talipes being most exactly simulated. The mode of occurrence, the history of the case, and the general condition and aspect of the patient will usually aid the diagnosis. This curious condition of the nervous system, it is to be remembered, is not confined to the female sex, as the name 'hysteria' would imply.

One of the most marked cases of this kind of talipes that I have seen, occurred in a boy of eleven years, who was brought to me to be operated upon for the deformity. As the case is a typical one, it may be worth while to relate it. The patient was a very intelligent, black-haired, nervous, self-conscious boy of semi-French extraction, who had been petted and spoiled by a foolish mother. The left foot presented the appearance of severe Talipes equino-varus, which I was told had come on rapidly after a slight sprain, three months before. On examination of the boy, I found that he was wearing a leather splint over the right hip-joint, and that at night he had an extension weight applied to the limb, for supposed hip-disease, which was said to have suddenly attacked him nearly three years previously. Further investigation elicited the fact that the symptoms of hip-disease which he exhibited were chiefly distortion of the limb (inversion and raised pelvis) and muscular rigidity; also that the severity of the disease varied, so that sometimes he would hop about actively, at other times he was confined to the sofa, or would only move with the aid of crutches. He was much pitied by numerous kind friends, who took pleasure in gratifying his taste and supplying him with any indulgences for which he expressed a wish. The mother implored me not to remove the splint from the hip, on account of the 'agony' that he would suffer; but after some persuasion I was allowed to take it off for the purpose of examining the joint, after having first applied the extending weight. I found that while I engaged the boy's attention in active conversation, the movements of the hip-joint were perfectly free, and that there was no sign whatever of real hip-disease either past or present. It was clear, in fact, that the condition of the hip, like that of the foot, was due to neuromimesis. It is needless to say that no operation was performed. A splint was ordered of a kind to prevent recurrence of the deformity, and which it was intended to apply to the foot when the distortion had been overcome with the aid of an anæsthetic. But before the day arrived for this, the deformity suddenly disappeared, and the foot regained in a moment a perfectly natural condition. I then insisted upon taking off the hip-splint, and, crutches and sticks having been removed, commanded the boy to stand upright, and then to walk. He immediately obeyed, and both his hip-disease and talipes were at an end.

In this instance there was no wasting of any of the muscles of the hip, and the history greatly aided the diagnosis. But it is well to bear in mind the occurrence of this kind of distortion in young people;[1] for in such cases it is often difficult to obtain an accurate history; the sympathy of the parents, who may be themselves of the same temperament, causing them to make exaggerated and misleading statements. In the case related, the position of the limbs was exactly that met with in the permanent diseases which were simulated, and with the other symptoms had led to the adoption of treatment for hip-disease, and to the recommendation of tenotomy.

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[1] In the museum of St. George's Hospital is an excellent cast of the lower limbs of a girl who was recently under Mr Pollock's care with simulated hip-disease. The position of the pelvis and lower extremity is exactly that assumed in the real disease, but there is no wasting of the muscles, and the deformity was entirely removed by the administration of either.

Disease of nervous centres.

Muscular spasm may be also due (*b*) to disease of the nervous centres.

Examples of this are seen in the cases of muscular rigidity following convulsions in children; in Duchenne's paralysis; and as a result of cerebral or spinal hæmorrhage or inflammation.

Reflex muscular spasm.

Another cause of muscular spasm (*c*) is peripheral irritation and reflex action. This is often seen in joint-disease, in which the irritation of the articular branches of the nerves which supply the neighbouring muscles, leads to a spasmodic contraction of those muscles, and thus, it may be, to considerable deformity.

Intestinal worms, teething and other similar irritations, may also give rise in children to reflex muscular spasm.

Traumatic talipes.

In addition to the varieties of non-congenital talipes above described, there are cases of traumatic origin, in which the deformity arises from wounds of nerves and the resulting paralysis; or from injuries to muscles, such as rupture or wound; or from cicatricial contractions, such as occur after burns.

Talipes due to position.

The long continued maintenance of a particular position may result in such an adaptation of the tissues to the conditions in which they have been placed, that the natural mobility and position of the part cannot be resumed, and deformity results.

The destructive effects of inflammation within or around joints may also lead to similar distortions.

Joint-disease.

The *treatment of non-congenital talipes* must of course depend upon its cause, but it is also necessary to take into consideration the general condition of the patient.

Treatment of non-congenital talipes.

In neuromimetic talipes attention must be directed to the treatment of the nervous disease, and the improvement of the health should be combined with judicious management of the mental condition. At the same time the distortion may be overcome by the administration of an anæsthetic, and its recurrence prevented by the application for a short time of a suitable splint. The patient should, however, soon be encouraged to use the foot, and the attention diverted by healthy occupation.

Treatment of neuromimesis.

In progressive disease of the nervous centres, accompanied by muscular spasm, much may be done for the prevention of deformity by the use of suitable apparatus, but no operative measures should be undertaken.

Treatment of talipes of nervous origin.

When the disease is stationary or at an end, tenotomy may occasionally be called for to assist the cure of deformity, in cases in which but a few muscles are affected, and the rest have sufficient power to make progression possible. But it is not often that such operations are useful in cases of muscular rigidity; for in the majority, either a large number of muscles are affected, and very little power remains, or there is so great a want of co-ordination that the muscles cannot be combined in any efficient action.

I need hardly say that no useful purpose is served by the operative treatment of deformities in idiotic children, whose cerebral condition in itself renders them helpless; but even in these instances the increase of the distortions, and the formation of troublesome sores and corns, may be prevented by the use of simple apparatus.

In cases of reflex muscular spasm, the treatment must of course be directed to the removal of the exciting cause.

When the stimulus arises in the articular nerves in consequence of joint disease, the most important indication is the maintenance of absolute rest. This may be obtained by the careful application of splints and bandages, or of extension-weights; and sometimes by tenotomy, which, by temporarily paralysing the irritated muscles, neutralises the effect of their contraction.

In other instances, a dose of compound scammony powder, or a salt and water enema, are appropriate means of purging the rectum of ascarides which may be the exciting cause of reflex spasm and deformity.

Treatment of traumatic talipes.

When a deformity arises from paralysis of muscles caused by the division of the nerve which supplies them, great benefit may result from effecting the junction of the ends of the divided nerve, by cutting down upon them, removing a small portion of each end, and fixing them together by sutures.[1] If this results even in the partial restoration of the function of the paralysed muscles, any remaining deformity, due to contraction of the muscles which retained their power, may easily be remedied by tenotomy, and a useful limb result.

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[1] Mr. Wheethouse performed this operation upon the great sciatic nerve nine months after its division, with the result of restoring to usefulness a limb which was so powerless that the patient wished it amputated. See Holmes' *Surgery*, p. 514, 2nd edition.

Distortions due to the contraction of cicatrices must be overcome by gradual extension, aided by such operative measures as may be possible in each particular case.[1]

The stiffness and contraction which result from the long continued immobility of a limb can usually be remedied by friction, passive exercise and gradual extension ; tenotomy is seldom necessary.

Occasionally cases of chronic joint-disease are seen which have come to an end with the foot in a distorted position—most often that of Talipes equinus. If ankylosis has not taken place, the restoration of the natural position may be aided by tenotomy and the use of Scarpa's shoe.

Treatment of results of infantile paralysis.

In infantile paralysis much may be done to remedy the resulting deformities ; and by thus enabling the paralysed limbs to be used, the most efficient aid is given to the improvement of whatever muscular power remains. I have already pointed out that a marked feature of infantile paralysis is the tendency to spontaneous recovery of the use of the majority of the affected muscles ; but in most cases some group or groups of muscles remain paralysed after the rest have recovered, and these after a few months undergo fatty degeneration. The consequence of this is a disturbance of the muscular equilibrium, whereby the opponents of the paralysed muscles, having no opposition to their action, become gradually shortened ; and their function being in abeyance, they also lose activity. Thus the paralysis of one set of muscles leads indirectly to the disuse and loss of power in others, and a limb may be rendered almost useless by the paralysis of but a few of its more important muscles. Although, probably, any of the voluntary muscles may be rendered feeble or useless by infantile paralysis, there are some which are more commonly affected than others, e.g. of single muscles, the deltoid, and of groups of muscles, those of the front of the leg. The lower limbs suffer more often than the upper, and the most common result of the disease is the loss of power, and wasting, of some few of the muscles of one leg.

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[1] The treatment of contracted cicatrices from burns is described in chap. v. p. 78.

In this manner arise the great majority of cases of acquired talipes; and from what has been said above, it is evident that Talipes equinus will be the form most frequently met with. A child affected with paralytic talipes of one foot will obviously be unable to walk without assistance; or, if it has not yet walked, will have to begin to use whatever power of progression it has, under great mechanical disadvantages.

It is therefore of great importance, in all cases of infantile paralysis, to take precautions against the occurrence of deformity, by the use of suitable mechanical apparatus; and to promote the nutrition of the limb by friction, passive exercise, and warm clothing. Galvanism has been extensively used in the treatment of this form of paralysis, but I cannot say that I have ever seen it of much service, though I have watched many cases in which it has been systematically and perseveringly practised for long periods. I do not assert that galvanism is of no use, but I believe it to be only one among other more efficient stimuli to the activity and nutrition of the paralysed part. It certainly seems to me to be of far less use than friction, the douche, and systematic exercise, passive or active, of the affected limb. By far the most efficient means of developing the power of an enfeebled muscle, is its moderate use alternating with its complete rest.[1] A little ingenuity, exercised in the application of this method to cases of infantile paralysis, will generally be well rewarded by the resulting improvement. For instance, in cases of paralysis of the anterior muscles of the leg, the nurse may be taught to practise passive flexion and extension of the foot ; or older children may do this for themselves by means of a strap attached to the boot. The children should, moreover, be daily encouraged to the voluntary use of the weak muscles, so that the first return of voluntary power, however slight, may be exercised and developed. Any mechanical assistance needed to aid the use of the limb should be given, but all such as leads to the disuse of the limb should be avoided.

It is interesting to observe, in cases of partial paralysis of a limb, how many movements can be produced by practice in the vicarious action of the muscles the functional activity of which is unimpaired. In cases, however, in which deformity has taken place, the first step in the treatment should be to remedy this by tenotomy, or whatever else is necessary to restore the natural position of the parts, and thus to allow of so much muscular power as remains being used with the greatest mechanical advantage. For example, when the foot is in the position of Talipes equinus, it will be needful, before the child can walk, to bring the foot to a right angle with the leg, so that the arch of the sole can be placed upon the ground. The natural position of the foot being regained, and appropriate support applied, the muscles which retain their power (as is usually the case with those of the hip-joint) can be brought into use to the best advantage, and progression is rendered possible.

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[1] See the section on Lateral Curvature for another application of this principle, pp. 149 and 150.

Non-congenital Talipes equinus.

Talipes equinus is by far the most common of the non-congenital forms of club-foot. It usually arises in consequence of paralysis of the anterior muscles of the leg, the heel being elevated by the unopposed action of the muscles of the calf. The position of the foot[1] is essentially the same as in the congenital form, but some modifications are met with, in accordance with the amount of muscular paralysis and the duration of the deformity. Thus when the anterior muscles are completely paralysed, the toes become folded backwards and the sole of the foot contracted, as in fig. 12; or, on the other hand, if the extensors of the toes retain some of their power, the phalanges may be drawn forwards, as in fig. 13. In either of these conditions, as will be seen by reference to the illustrations, the foot is shortened and its arch increased.

The treatment, as in the congenital form, will consist first in the division of the shortened structures, secondly in the mechanical restoration of the shape of the foot, and thirdly in the improvement of its nutrition and mobility by friction and exercise.

Operative treatment.

The tendo Achillis must be divided, and when the arch of the foot is increased, any contracted tissues in that situation must also be subcutaneously cut through.

Mechanical treatment.

The foot is then to be brought into position by the use of Scarpa's shoe or the splint represented by fig. 11.

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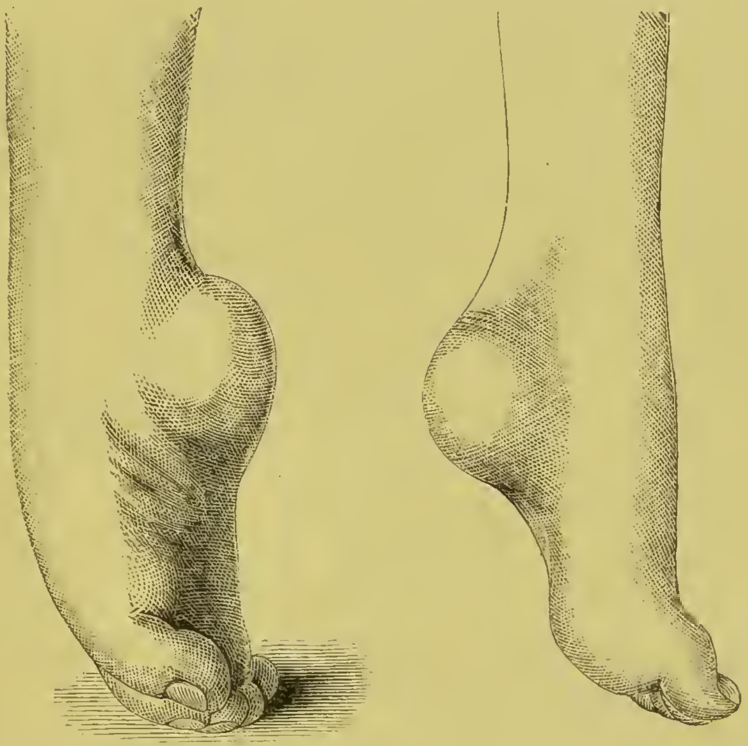
[1] See p. 11.

The latter answers perfectly well in most cases; but in severe examples, or when there is much contraction of the sole, it is better to use Scarpa's shoe, and to adopt the plan recommended by Mr. Adams, of stretching the sole before the tendo Achillis is divided.

Flexion of the foot should be carried to the extent which is permitted in the natural state of the foot, which it will be remembered is to an angle somewhat less than a right angle with the leg. This part of the treatment should occupy about a month, and should be immediately followed by friction and exercise.



FIGS. 12 AND 13.—VARIETIES OF PARALYTIC TALIPES EQUINUS.

(From models in the museum of St. George's Hospital.)

In paralytic cases it is necessary that the patient should wear, when walking, a boot with lateral supports extending to the leg, and with a joint at the ankle to prevent extension beyond a right angle.

Talipes cavus.

Cases are sometimes seen in which, with little or no elevation of the heel, there is considerable increase of the arch, and contraction of the sole, of the foot. To these the name of *Talipes cavus* is given. I have never seen this as a congenital affection, and the few cases I have met with have all been in young girls. In two of these cases the shortening of the sole was accompanied by contraction of the extensor proprius pollicis.

I am inclined to think that this deformity is sometimes produced by the present absurd fashion of wearing high-heeled boots. I have also seen it as a symptom of neuromimesis.

Treatment of Talipes cavus.

In some instances this variety of talipes yields to manipulation and the application of a splint, but in others it is needful to divide the plantar fascia, and perhaps the short flexor muscle.

Non-congenital Talipes calcaneus.

Non-congenital Talipes calcaneus differs from the congenital form, inasmuch as, being usually of paralytic origin, it tends to increase, and soon reaches a severe degree of deformity.

The muscles of the calf become stretched and wasted, the foot being flexed by the unopposed action of the anterior muscles. The heel is depressed and the os calcis, carrying with it the astragalus, may assume an almost vertical position. The sole of the foot is at the same time shortened, the anterior half of the tarsus being drawn downwards and backwards towards the heel (fig. 14).

Thus in progression the heel comes first to the ground, the elasticity of the foot is lost, and the gait is awkward and lame. In the early stages of the

Treatment

deformity care should be taken to prevent its increase, by the use of a boot with side-irons and a stop-joint at the ankle to prevent flexion of the foot; while every effort should be made, by friction and passive exercise, to improve the nutrition of the muscles of the calf. The metal shoe (fig. 11), or a light splint, must be worn at night.

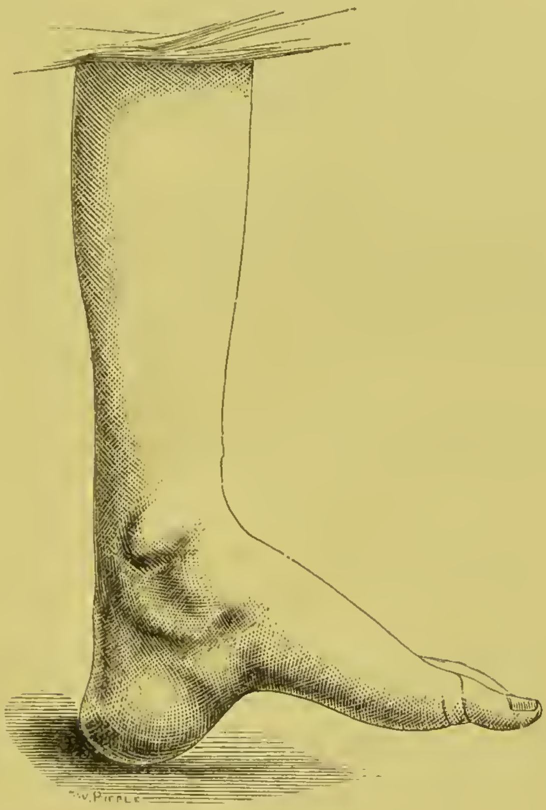


FIG. 14.—AN EXAMPLE OF PARALYTIC TALIPES CALCANEUS.
(From a model in the museum of St. George's Hospital.)

When the deformity is pronounced and the calf muscles remain paralysed, some improvement in walking may be obtained by adding to the boot and side-irons an elastic cord, fastened to the heel and to a metal band surrounding the upper part of the leg. If the sole is much shortened, the plantar fascia may be divided, and the arch pressed down by bandaging the foot to a metal shoe. The treatment of these cases is, however, but unsatisfactory at the best.

There is often combined with the condition above described, some little eversion of the foot, producing a distortion which may be described as *calcaneo-valgus* ; but this slight variation does not need separate consideration.

Non-congenital Talipes varus.

Non-congenital Talipes varus differs from the congenital form chiefly in the comparative absence of rigidity of the tissues, and in the defective nutrition of the limb.

In spasmodic cases, such as are seen in neuromimesis, the deformity may be extreme and the outward appearance of the foot exactly resemble the congenital affection ; in these the nutrition of the limb is not impaired, except after the long duration of the distortion. An example of this condition is related at page 36.

But in the majority of instances this deformity, when not congenital, is the result of infantile paralysis, and is accompanied by wasting of the muscles, and lowered vitality, of the limb. The foot, and perhaps the leg also, is cold and flaccid, and the skin has often a purple and congested appearance ; chilblains and troublesome ulceration of the skin are of common occurrence ; and I have even seen gangrene of the toes occur from very slight inflammation.

When the paralysis of the muscles of the leg is very complete, the varus position is gradually produced, and the limb is often a worse than useless appendage. In such cases I have seen amputation performed with much benefit, as a means of ridding the patient of a source of suffering and annoyance, and rendering possible the use of a wooden leg.

Very often, however, some of the muscles escape the paralysis; in which case the nutrition of the limb is less defective, and much improvement may be obtained by remedying the distortion.

The anatomical changes are much less marked in non-congenital than in congenital varus, and though the foot may be much distorted, it has not the rigid resistance which would characterise the same degree of the congenital deformity. In paralytic varus the outline of the foot and its anatomical characters are ill defined, and after long duration it is prone to exhibit ulcers over the points of pressure, instead of the thickened skin seen in the uncured congenital cases.

Prognosis.

The success of the treatment of this variety of talipes will be in proportion to the amount of muscular power remaining in the limb. Thus in spasmodic cases of short duration, a complete recovery may be anticipated from treatment based upon the general principles I have laid down at pages 41–43.

In paralytic cases the result will depend not only upon the number of muscles affected, but upon the duration of the deformity, and the amount of wasting that the paralysed muscles have undergone. When even but a small amount of power remains, if the wasting is not advanced, great benefit may result from the restoration of the normal shape of the foot, and the use of mechanical supports. These means enable whatever muscular power remains to be brought into use, and this exercise, together with friction and warmth, may lead to the development of increased power and improved vitality.

Treatment. The operative and mechanical treatment will be similar to that I have described as required for congenital varus.

The anterior tibial tendon will usually require division, and sometimes the posterior tibial. Section of the tendo Achillis is less often needful.

Great care is required, in the management of these cases, to prevent the formation of sloughs from the pressure of splints and bandages. The impaired vitality of the skin leads to the occurrence of sores on very slight provocation, so that whatever apparatus is used must be frequently readjusted, and the condition of the skin over all points of pressure carefully watched. It is best, I think, to remedy the inversion by the use of a splint, as described at page 23. Subsequently, after division of the tendo Achillis, the metal shoe (fig. 11) should be applied, and by means of the thumb-screw the position of the sole-plate can be gradually altered so as to overcome any elevation of the heel.

I prefer this shoe to Scarpa's, whenever it can be used, for paralytic cases, because there is less chance of producing sloughs when the foot is retained in the apparatus by bandaging, than if straps are used for the purpose ; and as in paralytic talipes there is but little rigidity to overcome, the simpler apparatus is usually quite efficient.

If sores have unfortunately occurred before the treatment is undertaken, its difficulties will of course be greatly increased. The first step will then be to endeavour to heal the ulcers, which usually require some stimulating application. I have found nothing answer so well as Peruvian balsam, spread upon a piece of lint exactly the size of the ulcer ; but whatever is used it is of the greatest importance to maintain the heat of the limb by warm clothing. A large knitted woollen stocking, which is elastic as well as warm, should be drawn over the limb. This can be used over any apparatus that is subsequently applied, and should be worn after, as well as during, the treatment. Care should also be taken of the general health of the patient, which should not be interfered with by unnecessary confinement. Fresh air, warm loose clothing, and the addition of a little wine to the diet, are aids which materially influence the progress of such patients. When the ulcers are healed they should be protected from pressure by rings of adhesive felt or of india-rubber. The skin, over any of the bony prominences, should be also thus guarded, and may besides be hardened by the use of a lotion of perchloride of mercury dissolved in spirit.

When the distortion has been remedied, the use of the limb must be encouraged; and for this purpose, and to prevent relapse, mechanical aid will be needful.

Apparatus of support.

The kind of apparatus used for support must, of course, vary with the degree of paralysis; but it should be so constructed as to interfere as little as possible with the natural movements of the limb, while affording the required support, and restraining the tendency to recur to the distorted position. If the muscles of the leg only are weak, a boot with side-irons attached to a metal band which is strapped round the calf, will give sufficient support. If the thigh muscles have lost power, the irons must be carried above the knee, and the outer one attached to a pelvic band. At night the metal shoe (fig. 11) may be worn.

Many variations from the typical forms of acquired talipes described above are met with in practice, and these will need to be treated on the same principles, with such modifications of detail as the peculiarities of each may require.

In concluding this part of my subject, I would only further urge the extreme importance of the careful examination of each individual case, so that the accurate ascertainment of the cause of the deformity may determine rightly the method of its treatment. For when it is considered that the same or allied deformities are produced by so many and various causes, it must be evident that a right diagnosis is only to be arrived at by an investigation which extends beyond the affected limb, and includes the general condition of the patient.

CHAPTER II.

TORTICOLLIS, OR WRY-NECK.

1. Torticollis, or wry-neck, may be congenital or non-congenital.

In either case the deformity is produced by contraction of the sterno-mastoid muscle, and usually also of the trapezius, whereby the occiput is drawn towards the shoulder of the affected side, and the head rotated so that the chin points towards the opposite clavicle.

Congenital wry-neck.

In the congenital form the condition of the affected muscles closely resembles that observed in club-foot. The sterno-mastoid is in a state of spastic contraction, and with the lapse of time becomes very much shortened. It is said that sometimes only part of the muscle is affected, the clavicular or the sternal portion being contracted, while the rest of the muscle is in a natural condition. My own opinion is that the whole muscle is always involved in the contraction, although in many cases one part stands out more obviously than the rest. I have always observed that when the tenser portion has been divided, the rest of the muscle comes into relief, and is seen to be also shortened.

Muscles concerned

Although the sterno-mastoid is the muscle chiefly concerned, the trapezius very often has also a share in the production of wry-neck, and in cases of long standing other muscles undergo shortening, from adaptation to the distorted position.

Results if not treated.

If the deformity is not treated, it increases with its duration, and leads to secondary changes of great importance. The face and head on the affected side become atrophied, so that they are obviously smaller than the opposite side, a symptom which in severe cases soon begins to be apparent. At the same time the cervical spine becomes curved and twisted, the convexity being on the sound side, towards which also the bodies of the vertebræ are rotated, a condition giving rise to compensatory curves in the lower part of the column. The want of symmetry and the obliquity of the features are a great aggravation of the deformity, and, with the lateral curvature, furnish strong reasons for undertaking the treatment at as early a period as possible.

Dr. Little has shown that 'not unfrequently wry-neck appears to result from straining or injury to the neck during difficult labour, from traction of the head by instruments.'[1]

Wry-neck from inflammation of glands.

A common cause of wry-neck in children is inflammation or suppuration of the cervical lymphatic glands. In some of these cases the distortion arises from the child voluntarily holding its head on one side, so as to relax the tissues of the neck, and thus relieve the pressure upon the tender glands. But in others I have seen such severe and irresistible contraction of the sterno-mastoid, as to indicate clearly that the spinal accessory nerve was involved in the neighbouring irritation. In either of these cases the distortion disappears or is greatly diminished by the administration of ether or chloroform, in which respect they differ from those in which the head is drawn down by the contraction of inflammatory or cicatricial material, which may also have had its origin in glandular disease.

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[1] Holmes' *System of Surgery*, vol. iii. p. 702, 2nd ed.

Spasmodic wry-neck.

A form of spasmodic wry-neck is met with in children, which seems to depend in some instances upon eccentric nervous irritation, and in others upon disturbance of the nervous centres by mental or other causes. The chief diagnostic mark of this class is that the contraction varies in intensity, and sometimes temporarily disappears, or even changes sides.

Neuro-mimetic wry-neck.

Closely allied to these are the neuro-mimetic, or so-called 'hysterical' cases, in which the spasm of the muscles is often very severe. Here, again, the diagnosis may be assisted by the use of anæsthetics, under which the distortion disappears, and by the discovery of other evidences of nervous disturbance.

Paralytic wry-neck.

An occasional but rare cause of wry-neck is the paralysis of one sterno-mastoid, by which the muscular balance of the two sides is disturbed.

Wry-neck from disease of cervical spine.

It remains only to mention the wry-neck dependent upon disease of the cervical vertebræ, which of course differs from all the other forms, in that the bone disease is the important element in its production, and renders it proportionately more serious. It is generally accompanied by the characteristic symptoms of cervical caries; the extreme rigidity of the neck, the resistance to any kind of movement, the pain caused by pressure upon the vertex, the presence of inflammatory thickening, or perhaps of suppuration, and, it may be, the scrofulous aspect of the patient.

It is well to remember, however, that any of these symptoms may be absent even when there is advanced caries of the vertebræ. I have recorded[1] a case of wry-neck dependent upon extensive destruction of the atlas and axis, in which repeated and careful examinations failed to discover any evidence of the bone disease. The patient, a boy of eight years, and of healthy parentage, seemed to have nothing the matter with him except wry-neck. There was no pain on rotating, or nodding, or pressing, the head, no difficulty in raising it, none of the characteristic fear of moving the head; no thickening over the bones, no tenderness or swelling behind the pharynx. After a time, however, he began to lose flesh, and eventually died of tubercular meningitis. On post-mortem examination, it was found that the two superior articulating processes of the axis were greatly worn away by caries, the left being almost entirely destroyed; the odontoid process was reduced to about half its natural size, and the lateral masses of the atlas were extensively ulcerated.

Treatment.

The treatment of congenital wry-neck consists first, in the division of the sterno-mastoid muscle; secondly, in the restoration of the head to the straight position; thirdly, in manipulation and exercise of the muscles concerned.

Division of sterno-mastoid.

The sterno-mastoid should be subcutaneously divided about a finger's breadth above its attachment to the clavicle and sternum. The head being pulled upon by an assistant, so as to make the muscle tense, a puncture is made at the edge of the muscle with a sharp-pointed tenotome. Through this puncture the angle-pointed tenotome (fig. 9, *d*) is passed beneath one portion of the muscle, which is then divided by a slight movement of the knife towards the skin.

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[1] *Clinical Society's Transactions*, vol. iii. p. 7.

The remaining tendon should then be divided in the same manner, through a separate puncture, that portion being first cut which is the most prominent.

The wounds being closed with lint and plaster, the head should be at once restored as far as is possible to its natural position, and retained there by a suitable apparatus. It is very difficult to keep any instrument efficiently applied for this purpose, because of the roundness of the head, and the ease with which pressure produces a sore upon the skin of children.

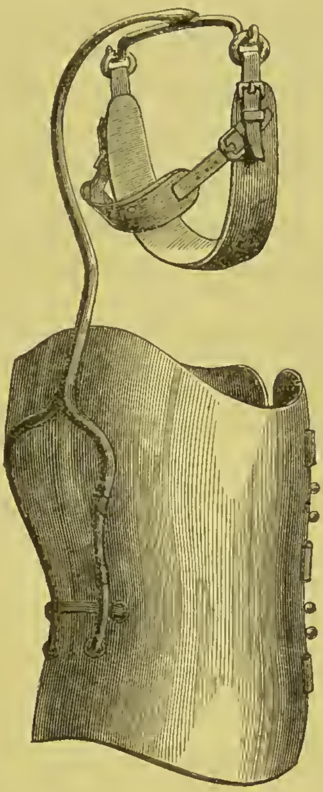

FIG. 15.—JACKET OF LEATHER, OR 'POROPLASTIC' MATERIAL, WITH IRON SUPPORT FOR THE HEAD (SAYRE'S 'JURYMAST').

While the patient is kept in bed, the simplest means of retaining the head in position is to secure it in a padded wooden frame, which is fixed to the bed and to the shoulders of the patient.

A poroplastic or leathern jacket, with an iron support to which the head can be fixed by straps, is also an efficient appliance, and is the best kind of apparatus for the patient to wear when up and about (fig. 15).

Mechanical treatment.

For cases in which the head can at once be brought to the natural position, a poroplastic or leathern collar, moulded accurately to the shoulders and head, may be applied to prevent a recurrence of the deformity.

About ten days after the tenotomy, manipulation should be commenced, the head being systematically pulled and twisted in a direction opposed to that of the distortion. This should be done two or three times a day, the instrument being of course removed for the purpose.

Passive exercise of this kind should be practised for a considerable time after the distortion has been overcome, and precautions should be taken against a recurrence of the deformity, by causing some form of apparatus to be worn as long as there is any such tendency.

In non-congenital wry-neck, section of the sterno-mastoid is less constantly required.

When the deformity depends upon disease of the cervical glands, it will be well first of all to ascertain how far it yields under the administration of an anæsthetic.

If when muscular relaxation has thus been produced, the sterno-mastoid still remains tense, it is better to divide it at once ; the necessity for the operation will usually be found to depend chiefly upon the duration of the contraction. If, however, the natural position can be at once obtained, the head should be fixed before the patient recovers from the anæsthetic, and a restraining apparatus applied as soon as possible. Sand pillows may be temporarily used for this purpose. Passive movements must be daily used, and may be combined with friction with oil or other lubricants.

In the spasmodic form of wry-neck of nervous origin, careful search must be made for any cause of irritation, such as intestinal worms, phimosis, or constipated bowels. If the distortion does not disappear upon the removal of any such source of irritation as may be discovered, ether should be administered, and the head placed in a restraining apparatus to keep it in good position ; this should be followed by daily manipulation.

Hysterical wry-neck is often a very troublesome affection—the muscular spasm being extremely severe, and only to be overcome by the use of an anæsthetic. The treatment should be directed to the condition of the nervous system, and carried out, as far as possible, without apparatus or special attention to the neck. The shower bath is often a valuable aid to other treatment.

When wry-neck depends upon caries of the cervical spine, the position may be very cautiously and gradually remedied ; and by the long-continued maintenance of complete rest, combined with the administration of appropriate tonics, the patient will be placed under the conditions most favourable for the arrest of the disease and the production of ankylosis.

CHAPTER III.

DISTORTIONS OF THE UPPER EXTREMITY.

In the upper extremity, contractions and distortions are met with of analogous kinds to those which have been described as affecting the lower extremity; but the hands are much less often affected than the feet.

Club-hand.

Flexion of the fingers, and of the hand at the wrist-joint, is met with as a congenital condition, and somewhat resembles club-foot. The muscles and other soft parts are contracted on the palmar aspect, while those on the dorsal surface are unduly stretched.

Sometimes only one or two fingers are flexed; and this condition may be due, either to muscular contraction, or to a deficiency in the skin and perhaps in the palmar fascia.

Infantile paralysis.

Similar distortions, usually in the direction of flexion, are also seen as the result of infantile paralysis; and cases also occur similar to those described at page 35, in which a number of the muscles are in a state of permanent rigidity, and the distortion of the hand is only one among other manifestations of disease of the nervous centres.

Reflex contractions.

Transient contractions are commonly seen in children, in consequence of peripheral irritation; familiar examples of which are the clenched hand, or adducted thumb, associated with teething or with intestinal irritation.

Neuro-mimesis.

Severe contractions of the upper extremity are also met with in cases of neuro-mimesis.

Treatmen

The treatment of congenital contractions of the hand is much less satisfactory than of the corresponding deformities of the foot. When only one or two fingers are affected, the condition of flexion may be overcome by the application of a splint to the palmar surface of the forearm and finger. The splint should be of flexible metal, which can be gradually straightened as the tissues yield. Daily manipulation, and friction of the contracted surface with oil, must be perseveringly carried on at the same time. If when the skin has yielded, any band of contracted fascia or tendon can be felt, this may be subcutaneously divided.

In the cases in which flexion at the wrist-joint is added to contraction of the fingers, prolonged attempts should be made to overcome it by the use of splints and daily manipulation, for tenotomy in this condition is not followed by satisfactory results. As the children grow older, use of the hand and fingers should be encouraged, the splint being always worn at night. If after some improvement has been obtained by these means, there are any tight bands of fascia or tendon which appear to resist further extension, they must be subcutaneously divided; but this should not be done until mechanical extension and manipulation have been perseveringly used.

When contraction is due to infantile paralysis affecting the muscles of the forearm, every effort should be made to improve the nutrition and power of the weak muscles, by friction, exercise, and the careful maintenance of the temperature by warm clothing; at the same time that suitable apparatus is applied to overcome the deformity, or at least prevent its increase. Much may be done by the proper use of simple splints, and it is to be remembered that daily attention is of more value than complicated apparatus. Whatever appliance is used, it must be removed every day for the proper exercise of the part; and it is worth while to instruct the parents or nurse in the kind of manipulations which are required, so that this part of the treatment may be efficiently carried out for a long period.

These cases, as well as those of reflex and hysterical contraction, must be treated on the general principles enunciated concerning the analogous condition in the lower extremity (see pp. 39–40).

Webbed fingers.

Webbed fingers is a not uncommon congenital deformity. Some, or all, of the fingers are joined by a band of skin which stretches across the natural cleft between them. The affection is symmetrical and occurs in the toes also. It is of so little consequence in the toes that it is not worth while to interfere with it; but in the hands it is an obvious deformity as well as inconvenience, and should be operated upon as soon as the child is in suitable condition.

Treatment of webbed fingers.

The operation which seems to me by far the best, and from which I have obtained excellent results, is that which I believe was devised by M. Didot, of Liége, a description of which is here copied from Mr. Erichsen's work on surgery:[1]—

Operation.

'Supposing the index and middle fingers to be webbed, the following would be the procedure to be adopted, which is of course equally adapted to any of the other fingers: 1. The surgeon makes an incision along the median line of the palmar aspect of the index finger, extending the whole length of the web. 2. Two small transverse incisions are now made at the upper and lower ends of the longitudinal incision, extending from it to the ends of the web. 3. The rectangular flap thus defined is dissected back as thick as possible, so that its base corresponds to the mid-line of the web. 4. A corresponding longitudinal incision is now made along the dorsal surface of the middle finger, but comes rather further down on the hand. The two transverse incisions at its upper and lower ends are next made, and the flap thus defined is dissected back, and when the knife reaches the mid-line of the web, the fingers will be found to be separated. 5. The next and last step of the operation is to wrap each flap round the raw surface of the finger to which it continues to be attached, and to fix *in sitû* by three or four points of suture. Thus the raw surface on the index finger will be covered by the flap taken from the dorsum of the middle finger and *vice versâ.*'

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[1] *The Science and Art of Surgery*, by J. Eric Erichsen. 7th ed. vol. ii. p. 365.

Contraction of the Palmar Fascia (Dupuytren's Finger-Contraction).

Dupuytren's finger-contraction.

This is a disease in which one or more of the fingers are drawn down towards the palm of the hand, in consequence of a thickening and contraction of the palmar fascia and its digital prolongations. It is usually associated with the name of the distinguished surgeon who first accurately described its pathology, and is conveniently distinguished as 'Dupuytren's finger-contraction.' The disease commences as a

Morbid anatomy.

thickening and hardening of the central or the inner portion of the palmar fascia, which can be felt as a dense knot beneath the skin of the palm. To this knot after a time the skin becomes adherent, and from thence can be traced, usually toward the inner fingers, hard cords of similarly indurated fascia. At the same time the fingers to which the cords of fascia pass, are gradually drawn towards the palm, and sometimes the second phalanx becomes bent upon the first. Occasionally, however, the thickening first affects the digital portion of the fascia, and spreads from thence upwards towards the palm. In these cases the second phalanx of the finger becomes bent upon the first, before the first phalanx is drawn towards the palm.

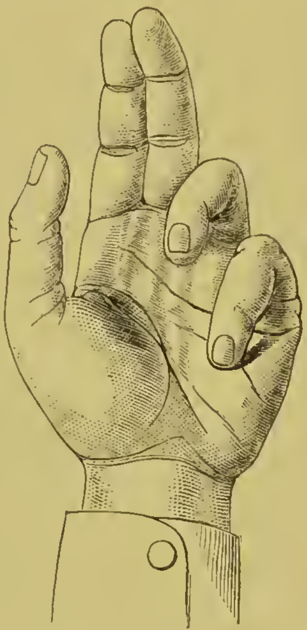

FIG. 16.—AN EXAMPLE OF DUPUYTREN'S FINGER-CONTRACTION.

(From a model in the Museum of St. George's Hospital.)

In the late stages of the disease, the hardening of the fascia extends from the centre of the palm, upwards towards the wrist.

The progress of the disease is slow and almost painless, the distortion of the fingers being the chief inconvenience to which it gives rise.

The little and ring fingers are by far the most commonly affected, although the disease may spread to the fascia of the outer fingers; and more rarely even to the thumb. It is most frequently met with in men after the period of middle life, and is seldom seen in young people, or in women.[1]

Causes.

I believe that this affection may be generally looked upon as a manifestation of the gouty diathesis, although it may probably be developed, as well as aggravated, by a use of the hands involving pressure upon the palms. But sometimes no constitutional nor local cause can be discovered to account for the occurrence of the disease.

Dupuytren[2] showed by most careful dissections, that the essence of the disease was the contraction of the palmar fascia, and that the tendons and joints were entirely unaffected.

It is true that in some of these cases the joints of the fingers may be enlarged by rheumatic gout; but this is an accidental complication.

Treatment.

The best method of treating this deformity is that introduced by Mr. Adams,[3] which consists of 'making subcutaneous divisions of the fascia and its digital prolongations,' and 'bringing the finger, or fingers, as nearly as possible into the fully extended position, at the time of the operation,' a retentive splint being worn for some time afterwards. Mr. Adams justly points out that having regard to the pathology of the disease, we should endeavour 'to widen as quickly as possible the gaps made by the incisions in the fascia, with the view of preventing union of the divided fascia, or to have the union as feeble as possible; objects precisely the reverse of those we desire to obtain after the subcutaneous division of tendons.'

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[1] Mr. Adams (*Observations on Contractions of the Fingers*, &c., Churchill, 1879, p. 1) says he has never seen it in women. I have, however, recently had under my care two young women in whom the disease was well marked; one a nurse, of gouty ancestry, the other a housemaid, who was apparently in perfect health.

[2] *Leçons Orales*, vol. i. p. 3, Baillière, Paris, 1832.

[3] *Op. cit.* p. 48.

The contracted bands should be divided by the small knife represented at *a*, fig. 9, the blade of which should be introduced between the skin and the fascia, the section being made from without inwards. Mr. Adams recommends that the first puncture should be made over that part of the fascia nearest to the wrist, the second dividing the same band near the web of the fingers, so that the portion of fascia between the two divisions, which is often adherent to the skin, is isolated from its connections above and below. Other punctures must be made at the webs between the fingers, for the division of the lateral bands of contracted fascia. Lint and plaster should be applied to the punctures in the same manner as after tenotomy. The hand and fingers should then be bandaged to a well-padded metal splint, applied with the fingers as nearly as possible in a condition of complete extension.

Mechanical treatment.

If only the first phalanx of the finger is flexed, immediate extension can usually be made, unless the contraction be of very long standing; but if the second phalanx is also flexed, the finger can only be partially straightened at first, and the remaining extension must be made gradually, either by splints, or by a special instrument with rack and pinion movements for the purpose.

After the contraction has been completely overcome, or if immediate extension has been made after about three weeks, the finger should be used, manipulation and friction with oil should be practised daily, and a retentive splint should be worn at night for two or three months.[1]

All advanced cases, I have no doubt, are best treated at once in the manner above described, to the success of which I can testify from experience; whereas for these, palliative measures are useless.

But in the commencement of the disease, before any considerable contraction has taken place, and while the thickening of the fascia is the most marked feature, I have seen much improvement from the use, locally, of the camphorated mercurial ointment, and the administration internally of remedies directed against the gouty diathesis.

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[1] See Adams, *Op. cit.* p. 55.

CHAPTER IV.

DISTORTIONS OF THE LOWER EXTREMITY—CONGENITAL DISLOCATION OF THE HIP.

Some amount of displacement of the bones of a joint is a not uncommon concomitant of many congenital deformities. Such conditions are found in combination with defective development of the bones and muscles, and often with paralysis and idiocy. These are not therefore true dislocations, but rather malformations, of which more or less displacement of the bones forms a part.

Congenital dislocation of hip.

But *congenital dislocation at the hip-joint* is met with, unaccompanied by any other abnormality; and in these cases there is usually no change in the head of the femur or the acetabulum at birth, although subsequently they undergo important alterations.

Causes.

Probably most of the congenital dislocations of the hip occur during parturition, as a result of traction made upon the thighs, to assist delivery in breech presentations. Mr. Brodhurst asserts that 'this dislocation never occurs except with a preternatural labour, and it occurs especially with a presentation of the nates.'[1] It is most common in the female sex. When only one femur is displaced, the condition will probably be discovered soon after birth, because of the difference in the length of the limbs; but usually the dislocation is of both hips, and then, the two limbs being similarly affected, it is often overlooked until the child begins to walk.

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[1] *Lectures on Orthopædic Surgery*, by B. E. Brodhurst, p. 160.

The head of the thigh bone is in all these cases found on the dorsum of the ilium, above and posterior to the acetabulum, where it can be felt on rotating the limb.

Symptoms.

When the child is old enough to stand upright, and to walk, the symptoms become pronounced and easily recognised. In the usual form of this dislocation, in which both limbs are affected, the appearance of the patient is peculiar and can hardly be mistaken. There is marked lordosis, and a corresponding prominence of the abdomen and buttocks. The trochanters project, and are at a higher level than is natural, that is to say, their upper border reaches above a line drawn from the anterior superior spine of the ilium to the tuberosity of the ischium. The pelvis becomes tilted obliquely forwards, so that the sacrum is unduly raised, and the lower limbs appear of disproportionate length. The child walks with an awkward gait, rolling the body from side to side, but without pain or difficulty. If only one hip is dislocated, there is of course an inequality in the length of the two limbs, and a more obvious limp; there is generally also a greater amount of weakness of the joint, and some wasting of the muscles.

Treatment.

The treatment of this deformity is attended with great difficulty, and can only be successfully undertaken in early life.

In young children, the dislocation can usually be reduced by moderate traction upon the limb in the extended position, but it is not easy to retain the head of the bone in the acetabulum. A well-fitting splint should be moulded to the pelvis and thigh, and extension kept up for several months before the child is allowed to use the limb.

Operative.

In older children, the tendency to displacement of the head of the bone may be overcome by the subcutaneous section of the muscles inserted into the trochanter, as recommended and practised by Mr. Brodhurst.[1] After the division of these muscles, especially the glutei and rotators, the head of the bone can be kept in the acetabulum by bandaging the limb to an ordinary straight splint, such as is used for fractured thigh.

Mechanical.

After two or three months passive movement should be employed daily; and when this has been practised for another month, if there is no tendency to displacement of the head of the bone, the child may be allowed to walk with a splint applied to the hip. As the joint gains firmness and strength, the restraining apparatus may be gradually dispensed with.

If, however, the dislocation is not reduced in early life, the acetabulum becomes altered in shape and partially filled up, and the head of the femur forms a cavity for itself upon the dorsum of the ilium, where a false joint is eventually formed.

Distortions of the toes.

Various *non-congenital distortions of the toes* are met with, besides those described in connection with club-foot, most of which are the result of wearing too narrow, or otherwise badly-shaped, boots.

The most common distortion of this kind is the displacement outwards of the phalanges of the great toe, whereby a partial dislocation takes place at the metatarso-phalangeal joint, and the head of the metatarsal bone becomes unduly prominent on the inner

Bunion.

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[1] *Op. cit.* p. 167.

side of the foot, fig. 17. The pressure to which the head of the metatarsal bone is thus subjected gives rise to the formation of a 'bunion,' that is, to a thickening and induration of the skin over the bony prominence, and the development of a bursa between the skin and the joint beneath. In the course of time other changes ensue. The great toe is thrust beneath the adjacent toes, which are pushed upwards and backwards; the internal lateral ligament of the distorted joint becomes elongated; and adhesions form between the bony projections on the outer side of the head of the metatarsal bone and the base of the first phalanx. In persons with a gouty or rheumatic tendency the head of the metatarsal bone often becomes enlarged, especially on its inner side. The articular cartilage is more or less absorbed, and the movement of the joint greatly restricted. In all cases of this deformity, the elasticity and mobility of the foot are materially impaired, and in many instances, much suffering is caused by the frequent recurrence of inflammation of the bursa.

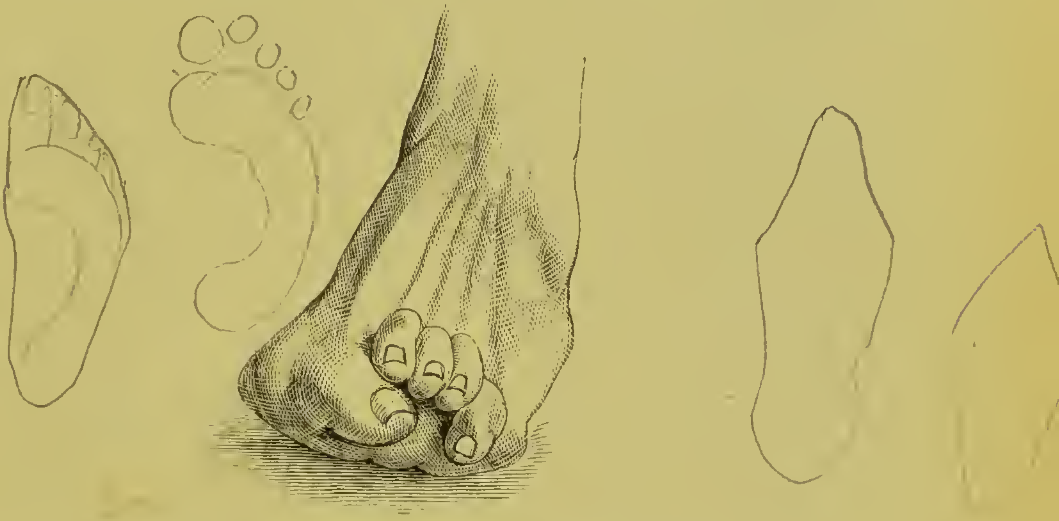

FIG. 17.—DISTORTION OF TOES, THE RESULT OF WEARING BADLY-SHAPED BOOTS.

This displacement of the great toe results from the foot being confined in too narrow boots; and the same cause often gives rise to a similar condition of the fifth toe, and to the angular flexion and thrusting backwards of the remaining toes, all of which are well shown in fig. 17, which is a very accurate representation of the foot of a man, whose toes had been thus distorted for several years.

Treatment.

The first essential in the treatment of this condition of the toes, is that only well-fitting boots, with a sufficiently wide sole, should be worn.

It may not be out of place here to point out that in the natural condition of the foot, the great toe is in a nearly straight line with the inner border of the foot; so that a boot which is narrowed towards the point, by the sloping outwards of its inner border, is incorrectly made, and must necessarily tend, as we so often see, to produce the displacement of the great toe which is described above. From the second to the fifth the toes gradually diminish in length, so that if the wearer so choose, the boot may be made with a corresponding slope on the outer side, without producing any harmful pressure.

In recently formed bunions and in cases wherein the displacement outwards of the great toe is not of long duration, it is sufficient that the distorted phalanges be strapped to a narrow splint, fixed to the inner border of the foot, and thus brought into a right line with the metatarsal bone. The bunion should be protected by a horseshoe-shaped piece of felt, and the boots made of sufficient width to admit of the splint without uncomfortable pressure. For some time after the splint is discontinued, it is well to have the boots made with a separate space for the great toe, to prevent any recurrence of the outward displacement.

When, however, the distortion is of long duration, a satisfactory result can hardly be obtained without treatment which necessitates an abstinence from walking for a time; although when persons are unwilling to submit to this, a great deal of improvement may be obtained by the persevering use of the method described above.

In severe and long-standing cases, the patient should be confined to a couch; and while under the influence of an anæsthetic, the toe should be forcibly straightened as far as possible, the extensor tendon of the great toe being subcutaneously divided if it seems necessary. The foot should then be placed in a padded metal shoe, made after the fashion of that shown in fig. 11, but with a spring fixed to its inner border, to which the great toe is strapped, and thus held in position. If any inflammation of the joint ensue, it must be allayed by the use of ice, or other appropriate measures.

Subsequently, the prominence of the head of the metatarsal bone must be carefully protected from pressure, and the great toe placed in a separate compartment of the boot.

The displacement of the little toe may be treated in a similar manner.

Hammer-toes.

Cases are also met with, in which the toes are retracted towards the metatarsus and bent at an angle at the first joint; in the position in which the second, third, and fourth toes are seen in fig. 17. This condition, which is sometimes called 'hammer-toes,' may effect only one toe, usually then the second, and may be unaccompanied by any lateral distortion of the

Causes.

phalanges. It is often produced as seen in fig. 17, by the thrusting of the first and fifth toes beneath the second, third, and fourth; and by wearing boots which are too short, or which have high heels. Occasionally, however, it seems to arise in some disturbance of the nervous system and without any local cause.[1]

As a result of the pressure which is thus thrown upon the heads of the metatarsal bones, a troublesome bunion forms over their plantar surface.

Treatment.

In cases of this kind, when of long duration, it is best to commence the treatment by the division of the contracted extensor tendons of the toes; though this operation is not necessary in cases of recent origin. The foot is then to be placed in a metal shoe, fig. 11, in the sole plate of which are slits, through which tapes or strips of plaster are drawn. These tapes are passed over the contracted toes, and being fastened beneath the sole of the shoe, draw down the toes into a natural position. Care must of course be taken that properly shaped boots are subsequently worn.

Ingrowing toe-nail.

Another very troublesome and painful result of lateral pressure upon the toes is *ingrowing toe-nail.*

The lateral edge of the nail grows into the adjacent skin, where it is a cause of great irritation. The skin first becomes inflamed and tender, then ulcerates, and subsequently from the ulcerated surface there springs up a prominent mass of granulations, which overlap the edge of the nail. These granulations are exceedingly painful and sensitive, and with the surrounding inflammation, are a source of great distress in walking; so that great lameness, and even total inability for active exercise, may result. The outer edge of the great toe-nail is the usual situation of the ingrowth, but the other toe-nails are occasionally affected.

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[1] See 'Cases of hammer-toes, showing the relation of this condition to spinal mischief,' by T. W. Nunn.—*Trans. of Clinical Society*, vol. xi. p. 153.

Treatment, if nail is dead.

If the duration and severity of the disease has been such as to destroy the nail, so that it has necrosed and become as a foreign body, no good will be done without removal of the nail. The patient being placed under the influence of nitrous-oxide gas; the blades of a strong pair of forceps are to be thrust down to the root of the nail, which is to be pulled out of its bed, care being taken that no fragment remains. Strong nitric acid should then be applied to the granulations which overlapped the edge of the nail; and the rest of the ulcerated surface powdered over with nitrate of lead, and protected with a layer of cotton wool. Great care must be taken to ensure the proper growth of the new nail, for which it is essential that the affected toe be kept apart from the next, by a wedge of felt introduced into the cleft between them.

If nail is living.

Unless, however, the nail be dead, it is much better not to remove it; not only because the removal of the nail does not necessarily cure the disease, for the new nail often follows the mode of growth of the old; but also because the violence done to the matrix, frequently leads to disease of the new nail, which is apt to be thick, uneven, and irregular in its growth.

The treatment which I have for some years adopted, is the introduction of a piece of sheet lead beneath the ingrowing edge of the nail; a method which I have invariably found successful in permanently curing the disease, and which has the advantage of great simplicity, and of at once enabling the patient to walk with comfort.

The operation should be performed in the following manner (see fig. 18) :—The patient being placed under the influence of nitrous-oxide gas ; the granulations at the edge of the nail are destroyed by the free application of nitric acid, or if very abundant, are cut off, and nitric acid is applied to their base. Any superabundant acid having been neutralised by soda ; a small bone spatula, slightly concave on its upper surface, is thrust beneath the edge of the nail down to its root. The ingrowing edge of the nail being thus lifted out of its bed, a piece of thin sheet lead is passed down between the spatula and the nail. One edge of the lead should project about an eighth of an inch under the nail, the other or free edge is then turned over on to the upper surface of the toe-nail, to which it is accurately moulded ; the lead is then cut off to the length of the nail, and a strip of plaster placed across it to keep it in position. The

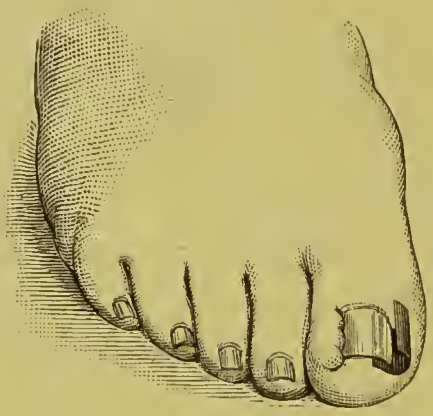

FIG. 18.—ILLUSTRATING THE TREATMENT OF INGROWING TOE-NAIL.

In the specimen represented, both edges of the great toe-nail are growing in ; granulations are seen overlapping the outer edge, and the lead has been introduced beneath the inner edge.

toe may then be covered with a piece of kid, like the finger of a glove, and a wedge-shaped piece of felt should be placed between the first and second toes.

The edge of the nail is thus encased in a sheath of lead which makes it impossible for it to grow into the adjacent flesh ; the ulceration caused by the ingrowth of the nail soon heals, and the skin in contact with the lead becomes hard and insensitive.

In the early stages of the ingrowth, the introduction of the lead beneath the nail can usually be accomplished without much pain, if the edge of the nail is first gradually and slowly raised from its bed by the little spatula, or by a director ; but if granulations have sprung up over the margin of the nail, the operation would give great pain, and it is better that the patient should take an anæsthetic. Very little pain is suffered after the first few hours from the introduction of the lead, and there is usually no difficulty in walking the next day.

Method of cutting nail.

As the nail grows, it should be cut in a straight line, and at a right angle to the border of the toe ; the lead being gradually shortened, until all that part of the nail which had grown in, has come to the free margin and been cut off.

The wedge of felt should be worn for a longer period, and the nail always kept with its free edge cut rectangularly, the corners never being sloped off.

CHAPTER V.

CONTRACTED CICATRICES.

Burns.

VERY severe deformity arises from the contraction of cicatrices, the result of burns. The power of such contractions is often surprising. The limbs may be held in a permanently flexed position, joints may be distorted or fixed, and the relations of parts greatly altered, by the slow but irresistible shortening of cicatricial tissue. Of course many of such deformities may be prevented by due care during the healing of burns and other sores; but sometimes it is impossible to prevent the contraction, and in other instances it has already occurred when the surgeon is consulted.

Treatment.

To remedy these deformities, much ingenuity may be exercised, both in the adaptation of mechanical extension to the scar, and also in the way of plastic operations, the aim of which is to replace the cicatricial tissue as far as possible by healthy skin.

Mechanical.

If the cicatrix is in such a position that an extending instrument with rack and pinion movement can be conveniently applied, the contraction may in many cases be overcome by such means. The process is necessarily tedious, and great care is needful to prevent the formation of sores from the pressure of the apparatus; still, when carried out very slowly, and with due attention to the condition of the skin, the method is often very successful.

I have used the pendent weight for the same purpose, with excellent results upon cicatrices, both of the upper and lower extremities.

But in many cases, it is impossible to use any such apparatus; either because of mechanical difficulties in applying it, or because the skin will not bear the requisite pressure; in these, therefore, some form of operation is necessary to remedy the deformity.

Operative.

When the scar forms a broad band, the method which I have found most successful is to dissect it from the subjacent tissues, leaving it attached only by its base, and to supply the wound thus left (which corresponds to about two-thirds of the surface covered by the scar) with skin, either slipped over from the immediate neighbourhood, or transplanted from more distant parts of the body. For instance, in a case in which the remnants of the fingers, left after a severe burn, were drawn back on to the dorsal surface of the metacarpus and completely concealed by the scar tissue, I was able to unfold the contracted fingers, and supply the needful covering for the back of the hand, from the skin of the abdominal wall.

Skin-grafting.

Where these methods are not possible, numerous grafts of skin should be implanted upon the surface of the wound, so that the resulting scar may approximate as nearly as may be to natural skin.[1]

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[1] If the scar which results from the process of skin-grafting is examined, it will be found 'that at the situation of the implanted skin, and for a radius from thence, varying from a quarter to half an inch, the scar approximates very closely to the nature of true skin; and as the distance from the implanted centre increases, becomes more cicatricial. From which this lesson is to be gathered, that the more numerous and the more closely placed are the centres of new growth, the more closely

When the cicatrix consists of a narrow cord-like band, it may be successfully treated by gradual and long-continued extension, if its position is such as to allow of the application of a pendent weight, or an extending instrument.

But there are often many difficulties in carrying out this treatment, and I have in several instances adopted with success a plan which I described in the 'Report on the Orthopædic Department of St. George's Hospital, for 1877–78,' from which I quote the following extract :—

'Among the cases of operation for contracted cicatrices, one may be mentioned in which the flexion of the forearm, due to a dense band of scar-tissue, resulting from a burn, was very efficiently remedied by making a series of **V**-shaped incisions through the band. These incisions were made about an inch apart, the apex of the **V** pointing towards the hand. By this means each piece of the scar so divided was allowed to slip upwards, and the wound resulting, to heal by approximation of the edges of the healthy skin. The result was that the forearm could be completely extended.'[1]

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will the scar resemble true skin.' See *Clinical Society's Trans.* vol. iv. p. 48.

[1] *St George's Hospital Reports*, vol. ix. p. 616.

CHAPTER VI.

ANKYLOSIS.

Causes of adhesions.

A FREQUENT result of inflammation within or around a joint is the formation of adhesions between adjacent tissues, by which the natural mobility of the limb is more or less impaired, or the joint becomes fixed in an useless or awkward position. In the same way inflammation of the sheaths of tendons, or of the connective tissue between muscles, may lead to the effusion of products, which undergo cicatricial contraction, or which bind together parts which ought to be freely moveable upon each other.

Symptoms of joint adhesions.

Even slight adhesions between joint surfaces having a considerable degree of movement are commonly attended with grave inconvenience; not so much from their interference with the natural freedom of movement, as from the recurrent attacks of synovitis of which they are the cause. Very much as an adhesion of the iris keeps up iritis, does an adhesion of the synovial membrane provoke synovitis; and the pain which the stretching of slight synovial adhesions gives rise to, is often sufficient to cause a degree of lameness in a joint, quite out of proportion to the impairment of motion which the adhesion would account for.

For this reason, joints in which adhesions are slight and few, are commonly much more painful and troublesome than those in which the adhesions are strong and numerous; and though the *possible* movement is greater in the first, the *actual* degree of motion is often greater in the second class, because the muscles involuntarily assist in fixing a joint, the movements of which are painful. Instances of this condition are often seen after sprains of the ankle; the patient can walk fairly well on flat ground, although it will be observed that he raises his heel but little; but in going up or down stairs, or over irregular ground, he experiences pain, and the effort is followed by increase of swelling.

The adhesions spoken of hitherto are of a fibrous character, and offer a variable amount of resistance to the movements of a joint; they give rise, therefore, to what is called 'fibrous,' 'false,' or 'soft' ankylosis.

'True,' or 'bony ankylosis,' is a comparatively rare condition. It is the result of advanced disease of the joint, in which the cartilages having been destroyed, the exposed surfaces of the bones have become united by granulations which have undergone ossification, the joint being thus obliterated and rendered absolutely rigid.

Fibrous ankylosis.

Fibrous ankylosis is either extra-articular, intra-articular, or both extra- and intra-articular.

Extra-articular ankylosis.

In the extra-articular form the stiffness of the joint depends upon the contraction of the cicatricial material around and outside the joint, and upon the agglutination of the neighbouring tissues.

This is best treated by the persevering use of passive exercise, aided by friction with oil, steaming the joint, and the application of the warm douche. Benefit is often derived also from the inunction of the camphorated mercurial ointment, or the oleate of mercury. If, however, any definite bands of contracted tissue oppose the movement of the joint, they should be subcutaneously divided, and any deeper adhesions which have not yielded should be broken down by forcible flexion, during anæsthesia.

Intra-articular ankylosis.

In the intra-articular form of fibrous ankylosis adhesions are formed between the opposed joint surfaces, but this condition is often combined with more or less stiffness, due to extra-articular inflammation.

Joints which are the seat of fibrous ankylosis present a great variety of appearances. There may be but slight vascularity or thickening of the synovial membrane, with a variable amount of fluid in its cavity ; or the disease may have progressed to ulceration of the articular cartilage, to exposure of portions of the bone, and perhaps to suppuration of the joint.

How far it is desirable to endeavour to obtain motion in a joint which has been the seat of past disease, is often a grave and difficult question to decide.

Ankylosis from scrofulous joint disease ;

No attempt at movement should be made as long as any active symptoms are present ; and in cases of scrofulous origin, great caution must be used lest past disease be rekindled, or residual inflammatory products be stimulated again into sources of active mischief.

But there are many cases of stiff joints due to adhesions, the result of traumatic inflammation in healthy subjects, in which the movements of the joint can be completely and safely restored.

from gonorrhœal rheumatism ;

Gonorrhœal rheumatism is a disease which very commonly gives rise to adhesions in the affected joint, and in which measures to re-establish motion may be successfully undertaken.

There is another class of cases in which long from traumatic causes.

continued immobility of a joint has been maintained in consequence of injury or disease, and in which the part is left cold, stiff, and slightly swollen, with some local tenderness, and pain on movement. In these also the prolongation of rest is harmful, and movement beneficial.

Sir James Paget has pointed out that 'too long rest is by far the most frequent cause of delayed recovery after injuries of joints in nearly all persons who are not of scrofulous constitutions. In the healthy, the chronic-rheumatic, and the gouty, it is alike mischievous; and not only to injured joints, but to those that are kept at rest because parts near them have been injured. Mere long rest stiffens them, and makes them over-sensitive; cold douches and elastic restraints and pressures make them worse, and nothing remedies them but movements, whether forced or voluntary.'[1]

Treatment.

In all such cases as I have above described, that is to say, joints stiff from adhesions after traumatic inflammation in healthy persons, or after gonorrhœal rheumatism; joints left cold and stiff after old sprains, or after long maintained rest; joints wherein are one or two slight adhesions, the stretching of which is a cause of recurrent synovitis;—in all these, forcible movement of the joint may be resorted to with great benefit. Probably the safest guide as to when this treatment may be used with advantage is that indicated by Sir James Paget, who says[2]: 'I believe you will be safe, if you will take the temperature of the part for your guidance. If the part be always overwarm, keep it quiet; if it be generally cold, or cool, it needs and will bear exercise and freedom from restraint of bandages, with friction and passive movements, and other similar treatment of the reviving kind. And of this you may be the more sure when the cold integuments over the joint are dusky-pink or purplish, or become so when the limb hangs down, and when there is little swelling, and when pain is much greater than is accounted for by any appearance of disease.'

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[1] *Clinical Lectures and Essays*, p. 97, 1st ed.

[2] *Ibid.* p. 94.

Tenotomy.

When a joint has been stiff for a long time, and the tendons around it have become contracted, it is best to divide the contracted tendons and any tight bands of fascia, as a preliminary to the rupture of the adhesions. A few days after the tenotomy, and when the punctures are healed, the adhesions should be ruptured by forcible flexion. In slight cases it is sufficient to administer nitrous-oxide gas for producing anæsthesia, but when the adhesions are numerous or strong, or when we are in doubt as to their character, it is best to place the patient under the influence of ether, which produces much more complete muscular relaxation than the gas, and allows of a more deliberate and accurate examination of the case.

Forcible rupture of adhesions.

The nature and position of the adhesions having been as far as possible ascertained, the proximal part of the limb is to be fixed by an assistant ; the distal part is then grasped by the surgeon, and suddenly flexed. The giving way of the adhesions is distinctly felt, and often heard. The limb should then be carried through all its natural movements, so that any remaining adhesions may be discovered and ruptured, finally, it should be fully extended ; but all adhesions should be ruptured, if possible, by flexion movements, and not by extension. An elastic bandage should then be applied over the joint, and the limb, both above and below the joint, enveloped in a bandage of domett, or other soft material. The limb is then to be kept at rest and well raised, for four or five days, and if the joint is painful ice may be applied. Then the bandage is removed, and passive movements and friction commenced, voluntary use of the joint being encouraged as soon as possible.

Of a good many cases which I have thus treated, chiefly the result of gonorrhœal rheumatism, I have never seen any harm result, although in some the rupture of the adhesions required all the force I could use. In many instances, in which the adhesions have been slight, or chiefly outside the joint, I have been able to rupture them without the use of any anæsthetic, by taking the patient by surprise, and when his attention has been engaged by conversation, and the muscles are, as it were, off their guard, suddenly flexing the limb. In such as these I have usually dispensed with any subsequent rest, and allowed the immediate use of the limb.[1]

After all such operations precautions must be taken by free movements, active or passive, against the re-formation of adhesions.

The same kind of treatment may be usefully applied to cases in which tendons have become adherent to their sheaths.

Bony ankylosis;

Bony ankylosis is much less common than fibrous, and when it does occur, is probably the most favourable termination of extensive joint disease which could be hoped for. Unless, therefore, the limb is fixed in an awkward or useless position, it does not usually call for any treatment.

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[1] Mr. Howard Marsh has related some interesting cases of this kind in a paper published in the *Clinical Society's Trans.* vol. xiii. p. 210.

of elbow;

To this rule there are, however, some exceptions. For instance, the elbow-joint, of which the excision generally results in so useful a false joint, that the operation is justified in most cases wherein the ankylosis cannot be broken down.

But in the lower extremity the case is different; here stability is the essential condition, a firmly ankylosed joint is often more useful than a weak and imperfectly moveable one, and the rigidity of one joint may be to some extent compensated by the increased mobility of others.

Unfortunately, however, instances are met with in which ankylosis has occurred with the limb in such a position that it is useless either for support or progression; and in these, operative interference becomes necessary. I may here point out that in many cases of firm fibrous ankylosis, the rigidity of the joint is so great as to make it difficult to distinguish between this condition and bony union.

But if ether is administered to the patient so that the muscles are completely relaxed, some slight yielding in the direction of flexion can be produced if the union be not bony.

of knee;

When bony ankylosis has occurred with the knee in the flexed position, excision of the joint in the usual method seems to me the best means of obtaining an useful limb.

Firm union in the straight position is to be desired in the situation of the knee-joint, and I think this more likely to result from the operation of excision, where two flat surfaces of bone are left in apposition, than by the operation of drilling or chiselling across the bones through a small opening in the skin, a method which must necessarily leave an irregular section, and which does not always enable the limb to be completely straightened.

of hip.

When the hip-joint is ankylosed in the flexed position, the femur is to be divided in the situation which seems most suitable, having regard to the condition in which the joint has been left by the previous disease.

Division of neck of femur.

If there is not much alteration in the neck of the thigh-bone, it should be divided after the method recommended by Mr. Adams, in which only a small skin wound is made, and the operation is performed as far as possible subcutaneously. A large tenotomy-knife, with a blade a quarter of an inch in width, is entered a little above the top of the great trochanter, and carried straight down to the neck of the thigh-bone. The capsule of the joint being freely opened, the neck of the femur is then to be divided ' by a small saw rather more than a quarter of an inch in width, and with a cutting edge an inch and a half in length at the end of a blunt shank three inches in length.' [1] The blade of this saw is passed along the track made by the knife, and the bone sawn from before backwards. A compress of lint is applied over the wound, and retained in position by plaster and a bandage.

Instead of the saw invented by Mr. Adams, the chisel described at page 120 may be used for dividing the bone.

After about three weeks the patient should begin to walk with the aid of crutches, and the limb is to be freely moved with the aim of procuring a false joint. In some of the cases in which this operation has been performed, free movement has been obtained at the point of section, where a false joint has formed; but in others, more or less ankylosis has occurred in spite of efforts to maintain motion. Nevertheless, with the limb in a straight position, a fixed hip-joint does not very greatly interfere with a person's activity.

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[1] See a paper by Mr. Adams on 'Subcutaneous Osteotomy,' in *Brit. Med. Journ.*, Oct. 18, 1879, p. 604, also *Med. Chir. Trans.* vol. lx. p. 1.

Division of femur below trochanters.

But in many cases of scrofulous disease of the hip, the neck of the thigh-bone is so much shortened, and there is so great an amount of new bone formed around the joint, that Mr. Adams's operation is not applicable. Even if there were sufficient of the neck of the femur left to render its division possible, it would be very undesirable to cut through a mass of new bone formed round the seat of disease, and thus to interfere with the remains of inflammatory products of scrofulous origin. When, in this condition of the hip, ankylosis has occurred with the limb in a position which renders it useless, Mr. Gant's operation of osteotomy below the trochanters may be resorted to with very good results. The shaft of the femur is divided by a narrow saw similar to that used for cutting through the neck of the bone, or a chisel such as that described at page 120, may be used for the purpose. The wound in the soft parts is closed at once with lint and plaster, and the limb having been brought as nearly as possible to the straight position, is bandaged to an outside splint, and kept at rest until union has taken place.[1]

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[1] See *Brit. Med. Journ.*, Oct. 18, 1879, p. 606.

CHAPTER VII.

RICKETS.

RICKETS is a constitutional disease, the effects of which are chiefly manifested upon the organs of motion, that is to say, the bones, muscles, and ligaments. These are all weakened, for rickets is essentially a debility, and its most obvious symptoms are due to the debility falling upon these particular organs. The bones bend, the muscles lack power, and the ligaments stretch; and thus are produced many of the deformities to which rickets gives rise.

Symptoms of rickets.

Besides these there are some other symptoms of rickets which it is important to know, because by the early recognition of the disease, we may be enabled to prevent the deformities which will presently be described. Unfortunately, the surgeon is usually not consulted till obvious deformity has occurred; but even then, the success of his treatment will depend upon his understanding the character of the disease as a whole, and will be marred by his taking the mechanical and restricted view which would look upon rickets merely as a disease of the bones, requiring only appropriate instruments to remedy their distortions. It will be convenient, therefore, to describe the general symptoms of rickets, before proceeding to the consideration of the deformities which ensue upon these.

Age at

The disease is one of infancy and childhood, and appears most often about the period when dentition begins. It may, however, occur much earlier, and perhaps even be congenital; or, on the other hand, its onset may be delayed till after the child has walked.

which rickets occurs.

Tenderness.

The commencement of the disease is usually marked by an extreme languor, and a dislike on the part of the child to be handled, because of a great tenderness of the whole body. There is also profuse sweating about the head and neck, and a tendency to kick off the clothing at night. The decubitus is peculiar; the child prefers to lie upon its back with the legs crossed, and the thighs flexed upon the abdomen. The child is restless and uneasy; but, as movement is fatiguing, it shows this chiefly by cries and moans, and by rolling the head from side to side. The fontanelles are late in closing; dentition is retarded; the teeth, moreover, rapidly decay and fall out. A varying amount of emaciation is observed in rickets, but it must be remembered that in the early stages of the disease, especially in young infants, the subjects of rickets are often very fat. I have seen a child so intensely rickety that it had not power to lift its limbs, and in whom the tenderness was so great that it shrieked if only gently moved, which yet was enormously fat, so that the enlargement of the ends of the long bones could only be detected by careful manipulation.

Sweating.

Decubitus.

Dentition.

Enlargement of viscera.

It is uncertain to what extent rickets is to be held accountable for enlargement of the liver, spleen, and lymphatic glands.[1]

My own experience is that in the early stage of nearly all cases of rickets, the lymphatic glands can be felt slightly larger and harder than natural, that the spleen is not uncommonly palpable, and that the liver is less often increased in size.

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[1] In the debate on Rickets at the Pathological Society (session of 1830–81) different opinions were expressed on this point by Sir William Jenner, Dr. Dickinson, and Dr. Fagge.

Convulsions.

A remarkable concomitant of the rickety condition is the great tendency to certain convulsive affections exhibited by rickety children, so that rickets may always be suspected if we see a child who has no marked fever, attacked by fits or laryngismus stridulus.[1]

Laryngismus.

This is a symptom of great importance; for a child, who seems to be but slightly rickety, may die of the convulsive complication.

Condition of bones.

The bones are affected in a notable manner. Their ossification is disordered and imperfect, so that the resulting bone is ill-formed and soft. Chemical analysis yields a deficient quantity of the bone-earths;[2] and the microscope shows excessive multiplication of the cartilage cells, the calcification of which is retarded and insufficient. The skull becomes thickened and enlarged, and its ossification is delayed. Thus it yields easily to pressure, and the fontanelles remain long unclosed.

Cranio-tabes.

Since Elsässer described, in 1843, the abnormal softening of portions of the parietal and occipital bones, called cranio-tabes, it has been usual to regard this condition as a symptom of rickets; but Drs. Barlow and Lees have recently adduced evidence showing that cranio-tabes is much more probably due to syphilis, and must therefore be removed from among the symptoms of rickets.[1]

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[1] Some observers maintain that laryngismus stridulus never occurs except in rickety children.

[2] The most recent analysis I have met with is that of Friedleben, quoted by Dr. Fagge (Discussion on Rickets at Pathological Society, 1880–81), from the *Jahrbuch für Kinderkrankheiten* of 1860. This gives the percentage of earthy salts in rickety bones at 33 to 52, as against the normal percentage of 63 to 65 yielded by the bones of healthy children.

Skull.

The shape of the rickety cranium is peculiar; it is flat and square, and the forehead projects as though it had been squeezed out by pressure on the vertex; sometimes it becomes elongated. But the cranium looks larger than it is, on account of the imperfect development of the bones of the face.

The other flat bones are similarly altered. The lacunæ are enlarged and the tissue generally expanded, so that the bones are thickened, while at the same time they are unnaturally soft.

Pelvis.

The pelvis may thus become deformed by the approximation of the sacrum and the symphysis pubis, the former being thrust downwards and forwards by the weight of the body, and the latter upwards by the pressure of the thighs; the distance between the tuberosities of the ischia is sometimes also lessened. The outlet of the pelvis may in this way be narrowed, so as to interfere with parturition in after years; and the displacement forwards of the acetabula gives rise to a peculiar rolling gait which often characterises the subjects of rickets.

Long bones.

The long bones undergo a like process of softening and expansion; and besides exhibit a marked enlargement of the ends of their shafts, due to the disordered and excessive production of the material for ossification, the calcification of which is imperfect and delayed. The periosteum, too, is thickened, and shows the same tendency to the overgrowth of soft and defective bone, and both it and the bone are unnaturally vascular.

Notable symptoms therefore of rickets are these enlargements of the ends of the long bones, which are especially marked at the wrists, ankles, knees, and anterior ends of the ribs. The ribs are usually the first affected, and exhibit the enlargement in the most marked manner; they may therefore be considered the test bones in the earlier and obscurer degrees of rickets.

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[1] *Pathological Society's Trans.* 1881.

Rickety curvature of bones.

The softness of the bones also causes them to bend as soon as they are subjected to pressure; so that when the rickety child begins to crawl or walk, the bones of the upper and lower extremities become bent in consequence of the weight thrown upon them, and thus are produced the numerous cases of bowed arms and legs, which are so strikingly characteristic of the disease. These curves are mostly exaggerations of those natural to the bones, but their position and direction are also influenced by the mode of progression adopted by the child. The bones may even be bent by muscular action before the child is capable of independent locomotion; and fracture, either complete or partial (the so-called 'green-stick' fracture), may easily occur from slight accidents.

Upper limbs.

The upper extremities usually show less deformity than the lower, for the obvious reason that they are less subjected to pressure. But the natural curves of the clavicle are often considerably increased, and the radius and ulna in many cases show a marked anterior concavity. In children who have been accustomed to push themselves about with their hands while sitting on the floor, as many rickety children do before they can walk, the bones of the forearm may become greatly bent just above the wrist. The humerus is less often bent, but in children who support themselves on their elbows it assumes a curve with an anterior concavity.

Lower limbs.

The thigh bone yields in a forward and outward direction, and so do the tibia and fibula, and thus the whole of the lower extremity may assume a curve with the convexity forwards and outwards ; a curve which is, however, divisible into two lesser curves, belonging respectively to the thigh and leg.

Bowed legs.

This bowing of the lower limbs, which is called *genu extrorsum*, or *bowed-legs*, is extremely common amongst rickety children ; it may subsequently become increased by the yielding of the ligaments of the knee and ankle, and often gives rise to great deformity. The knees are widely separated, the stature diminished, and the person walks with a peculiarly awkward gait ; this last is due to the necessity of throwing the weight of the body alternately from one limb to the other, so that there is a continual flexion of the trunk from side to side.

The tibia and fibula often show extreme degrees of rickety deformity from the children having been allowed to walk while the bones are soft ; and a sharp bend may be seen just above the ankle in those who have pushed themselves along the floor with one foot.

Pigeon-breast.

The soft condition of the ribs gives rise to certain thoracic deformities commonly met with in rickets. The chest walls yield to atmospheric pressure, the more so because of the weak inspiratory power of the child and the consequent tendency to pulmonary collapse ; and this yielding is more of the bone than of the cartilage, so that a lateral depression or sulcus is found running down the chest, just behind the junction of the ribs with their cartilages ; this is rendered the more apparent by the enlargement of the ends of the bones, which produces a row of nodules at the costo-chondral joints. Besides this the sternum is thrust forward, so that the antero-posterior diameter of the chest is increased, and the transverse diameter is diminished ; while the lower ribs are pressed outwards by the abdominal viscera.

Thus arises the 'pigeon-breast' of rickets, in which the ribs yield at their growing ends, and the sternum is thrust forward as a rounded prominence, so that the outline of the chest is a double curve. Sir William Jenner has pointed out that this form of 'pigeon-breast' can be distinguished from that which occurs from other causes, inasmuch as in all cases of pigeon-breast in non-rickety subjects 'the yielding of the ribs takes place where there is a natural maximum bend, at their angles ; the sternum is pushed straight forward, and the outline of the chest is angular.'

It will be seen that the changes which have been described as taking place in the bones, necessarily occur while the bones are soft and yielding. During this period, therefore, the resulting deformities may be to a great extent remedied ; for while the bones are capable of being bent they also admit of being straightened. But if this stage of softness of the bones is not taken advantage of for the application of appropriate mechanical treatment, the difficulty of straightening the bent limbs becomes enormously increased, and to a great extent insuperable.

Subsequent changes in bones.

For there ensues a further stage of the disease, in which the bones harden, and the expanded and softened tissue becomes filled up with a very dense material, which gives them an even greater hardness than the natural bones. If, then, the curves produced during the period of softness have not been remedied, they become permanent, and are, moreover, strengthened by the growth of strong buttresses of bone in the concavity of the curve (fig. 19).

Coincidently with the enlargement and softening of the bones, corresponding changes are taking place in the muscles and ligaments; that is to say, these organs are becoming soft and weak, and are consequently yielding to any pressure to which they are subjected.

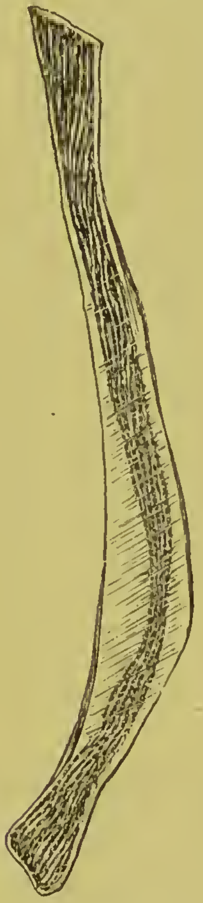

FIG. 19.—SECTION OF THE FIBULA OF AN ADULT WHO HAD BEEN AFFECTED WITH RICKETS IN EARLY LIFE.

The bone is seen to be much curved, and the section shows a thick layer of dense compact bone, chiefly in the concavity of the curve. From a specimen in the museum of St. George's Hospital. Ser. ii. 141.

Condition of muscles.

The condition of the muscles is remarkable; for they become extremely tender, and in acute rickets may for the time completely lose the power of contracting, so that I have known such a case mistaken for one of infantile paralysis.

I wish to draw especial attention to this symptom, because, although Sir William Jenner alluded to it in his well-known lectures,[1] it still seems to be less recognised than its importance deserves; and for this reason I believe that cases of acute rickets are not uncommonly overlooked or misunderstood.

It has been too much the custom to regard rickets as a disease of the bones, and to forget that it is a general disease of which the bone lesions are but a part. I would point out, however, that the bone changes are not always a prominent or obvious part of rickets, and that he who looks only for these signs of the disease will fail to recognise some of the most severe examples.

The cases in which the muscular weakness is most marked are those of acute rickets in very young children. I will relate an instance in illustration of this.

A child, ten months old, rapidly and almost completely lost the power of moving its extremities. The lower limbs were everted and motionless; the upper limbs were occasionally moved in a slow and languid manner. The child was enormously fat, he sweated profusely about the head and upper part of the body, and was intensely tender all over, so that he screamed if only gently touched. The fontanelle was widely open and depressed. The spleen was palpable. The upper incisor teeth only were cut. The father was a strikingly robust and healthy man; the mother fragile, having had children fast, but not otherwise unhealthy. Neither of the parents had been rickety. This was the fourth child, the three others being healthy. It had been tended with every care, but had been brought up by hand and fed partly on Swiss milk, and partly on a patent farinaceous food.

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[1] *Med. Times and Gazette*, 1860, vol. i. p. 259.

Here the muscular weakness was so great as at first sight to simulate infantile paralysis, and the bone lesions were very slightly marked ; but a careful examination revealed nodulation of the ribs and slight enlargement of the wrists. The child completely recovered under appropriate treatment, but while under observation the ends of the ribs became more obviously enlarged.

I have not had the opportunity of examining microscopically the muscles of so acute a case as this ; but in less severe examples the only change that I have found is that the muscular tissue is pale and ill-developed.

Even in less acute rickets, the muscular weakness may be one of the earliest symptoms. If a child who has walked becomes rickety, one of the first indications of the onset of the disease is an unsteadiness of gait, soon followed by an inability to walk. The mother says 'the child is taken off its feet.' This inability to walk is not because of the changes in the bones, which are probably coincident, but because of the muscular weakness, which shows itself in other ways,—*e.g.* the bowed spine of rickets depends upon the weakness of the spinal muscles, which are not strong enough to keep the spine erect ; the prominent abdomen is due not only to the enlargement of the viscera, but to the weakness of the abdominal muscles, which yield to the weight of the viscera they cover.

Knock-knee and flat-foot are other instances of muscular weakness; the muscles being weak, undue stress is thrown upon the ligaments, which, being soft, readily yield.

So that it is clear that to the changes in the muscles, as much as to those of the bones, are due many of the notable deformities met with in rickets. These deformities will now be considered in detail.

Rickety curvature of spine.

And first the *rickety curvature of the spine.* Children affected with rickets, when they begin to sit up do not hold the spine upright, but allow it to assume a general curve, with the convexity backwards. The whole spine assumes a bowed form; there is no angular projection as in caries, but one curve extending from neck to loins. This is because the ligaments stretch, and the muscles have not power to hold the spine erect. If the child be held up by the arms, with the lower extremities dependent, the curve is obliterated; the weight of the lower limbs pulls the spine into a straight line. This curve, it will be observed, is an exaggeration of that natural to infants; the back is thus bowed forwards during intra-uterine life, and it tends to assume the same position when the infant is so placed that the weight of the head is borne by the spine.

But as the child begins to walk, and the erect posture is assumed, the antero-posterior curves natural to the spine of adults begin to appear; and in rickety children these may become increased to an unnatural degree owing to the want of power in the muscles and ligaments of the spine; and thus is produced the condition called lordosis,[1] in which there is a forward bending of the bodies of the lumbar vertebræ causing a hollow at the loins, and a compensatory backward curvature in the dorsal region.

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[1] See fig. 20.

Besides these distortions, lateral curvature may be indirectly caused by rickets, in consequence of the lower limbs or pelvis having yielded to a greater extent on one side of the body than on the other.[1]

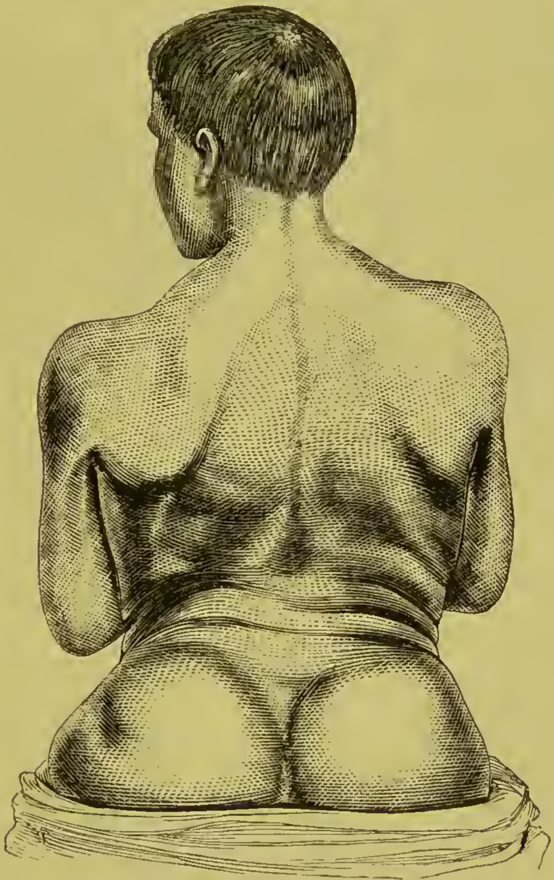

FIG. 20.—AN EXAMPLE OF LORDOSIS.

(From a model in the museum of St. George's Hospital.)

Prominent abdomen.

The abdomen of rickety children is large and prominent. This is partly due to the relaxed and weak condition of the muscular abdominal wall, partly to the displacement downwards of the viscera in consequence of the thoracic deformity, and in some cases to enlargement of the liver and spleen. It may also be to some extent dependent on lordosis.

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[1] An example of this unequal yielding of the two lower extremities is seen in fig. 21, p. 102, which represents a case of knock-knee, in which the greater yielding of the right knee has caused a corresponding shortening of the right lower limb.

Knock-knee.

Genu valgum, or *knock-knee*, is another result of muscular and ligamentous weakness, and is very common among the subjects of rickets. This deformity (fig. 21) is due to a yielding of the muscles and ligaments of the knee-joints, and especially of the internal lateral ligament, in consequence of which the

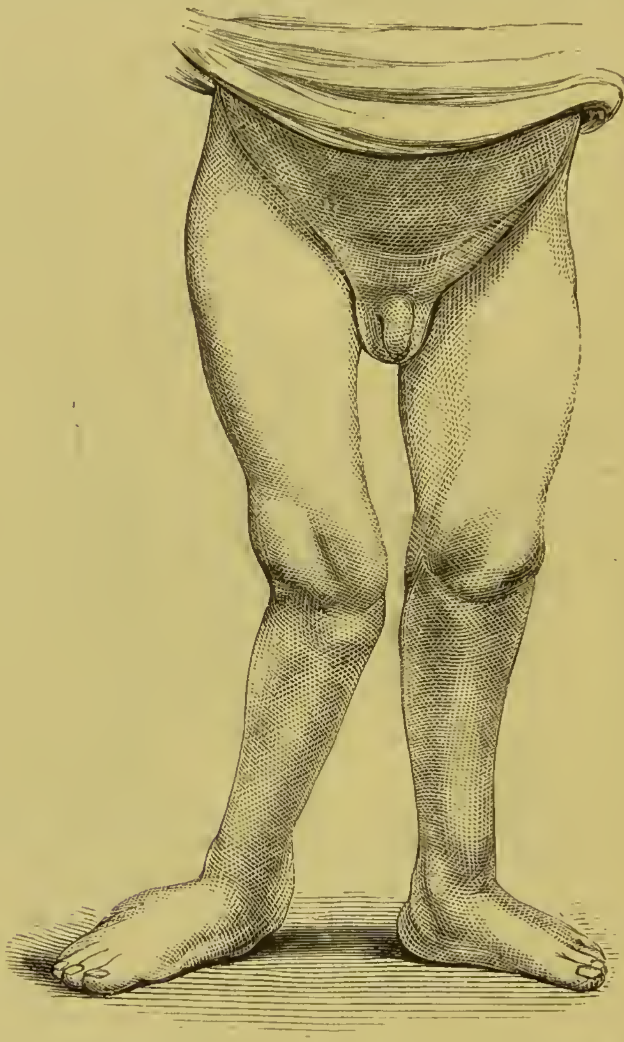

FIG. 21.—AN EXAMPLE OF KNOCK-KNEE AND FLAT-FOOT.

It will be seen that the right knee and ankle-joints have yielded to a greater extent than the left. (From a model in the museum of St. George's Hospital.)

obliquity in the direction of the femora becomes increased, so that the knees approach, and may touch, or even over-lap each other; at the same time the legs assume a proportionately divergent position, and the feet are widely separated. As a result of this, an increased stress is thrown upon the inner ankle, the lateral ligament of which becoming stretched, eversion of the foot takes place, and is usually accompanied by flattening of its arch. If the bones are still soft, the tibia often becomes bent just above the ankle, where it presents a sharp outward curve.

In cases of severity and long duration, the biceps becomes shortened, the fascia-lata tense, and the internal condyle of the femur unduly developed. The rickety enlargement of the ends of the bones is also an aggravation of the deformity.

The hypertrophied condition of the internal condyle of the femur is, I believe, a result and not a cause of knock-knee.[1] In the early stages of the deformity the ligaments can be observed to be weak and yielding before any such hypertrophy can be made out; and, moreover, properly applied pressure is capable in young subjects of greatly modifying the relative growth of the femoral condyles. The same may be said of the enlargement of the inner tuberosity of the tibia, which is sometimes present in these cases.

The outward bowing of the lower extremities, or *genu extrorsum*, is not usually associated with any corresponding overgrowth of the external condyle, though the ends of the bones exhibit the common rickety enlargement.

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[1] See a paper on the 'Anatomy of Genu Valgum,' by Edmund Owen, F.R.C.S. (*Journal of Anatomy and Physiology*, vol. xiii. p. 83.)

It will be evident, therefore, that in genu valgum the ligaments are chiefly at fault, whilst in genu extrorsum it is the curvature of the bones which gives rise to the deformity. It is for this reason that genu extrorsum only arises during the earlier stages of rickets when the bones are soft and yielding; but genu valgum is frequently seen to commence in rapidly growing youths and girls, whose bones are firm, but whose muscles and ligaments are weak. Moreover, if the bowed legs are not corrected, the ligaments, especially those of the inner ankle and plantar arch, become lengthened, and the foot flattened and splayed.

Flat-foot.

Flat-foot, or *spurious Talipes valgus*, is so often one of the symptoms of rickets that it is convenient to consider it in this association; but it may also arise independently of rickets, either from constitutional or local causes. It consists chiefly in a yielding of the plantar ligaments, and especially of the calcaneo-scaphoid ligament which supports the head of the astragalus and has so large a part in the maintenance of the antero-posterior arch of the foot. The tibialis posticus muscle and the lateral ligaments are also stretched. The natural arches of the foot, both antero-posterior and transverse, are flattened by the superincumbent weight of the body; so that the astragalus sinks, the dorsal convexity of the foot is diminished, and the inner malleolus approaches the ground and becomes unnaturally prominent. Besides these changes there is a varying amount of rotation outwards of the anterior part of the foot, at the transverse tarsal joint; and occasionally the outer edge of the foot may be slightly raised (fig. 22). The graceful shape and elasticity of the foot are thus lost, progression is impeded, and the increase of the deformity is often accompanied by much suffering. The pain is usually described as a severe aching, and is compared with rheumatism; so that in the early stages of the deformity, the prominence of the malleolus and the character of the pain sometimes cause it to be mistaken for rheumatic inflammation. Aching pain complained of in the region of the sole and ankle should therefore always suggest an examination into the condition of the arch of the foot.

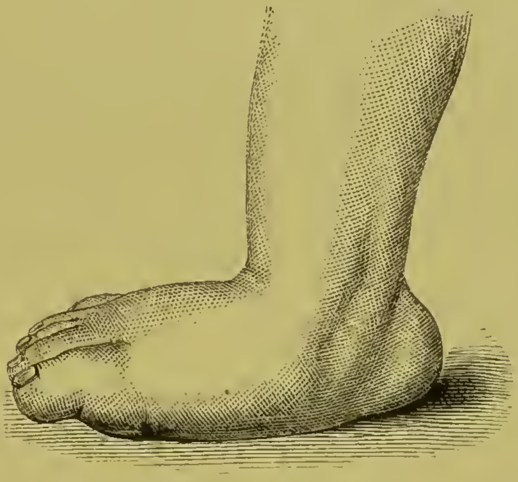

FIG. 22.—AN EXAMPLE OF FLAT-FOOT IN A RICKETY CHILD.

(From a model in the museum of St. George's Hospital.)

Cause of pain.

The cause of the pain I believe to be the stretching of the ligaments, which in accordance with the law of pain[1] resent this aggression upon their functions. It varies much in severity, both in different persons and in different stages of the disease. It is usually most severe in the early stages, when the stretching of the ligaments is going on ; and most continuous in the later stages, when the flattening is pronounced. It is of course worse after long standing, and therefore usually in the evening. The rickety cases as a rule suffer least, but sometimes instances are met with in which persons not rickety have acquired a severe degree of the deformity without the occurrence of any pain.

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[1] By 'the law of pain,' I mean that pain has a direct relation to function, and is Nature's indication that the function of a part is interfered with. Thus ligaments, being intended to sustain pressure and to resist the separation of parts which they bind together, become painful when stretched, but have little sensibility to other kinds of injury.

Other causes of flat-foot.

Besides the cases in which flat-foot is a part of the general debility of rickets, there are many in which it arises from other causes. It is often produced by long-continued standing, without intervals of rest, especially in growing girls and boys. Thus it is common among factory children,[1] pages, and young persons who serve in shops, who are often prevented by an absurd and inhuman rule from sitting down even when they are unemployed. Sprains and inflammations of the tarsal joints, which leave the ligaments softened and stretched, often lead to flattening of the foot. For this reason flat-foot, like knock-knee, may follow rheumatic inflammation of the joint, and the pain caused by the yielding ligaments may be mistaken for a recurrence of the rheumatism. In such instances, as well as in those that have their origin in traumatic causes, the deformity is often confined to one side ; whereas in those that arise from rickets or simple debility, it occurs on both sides of the body, although the two limbs may be affected to an unequal extent.

Causes of rickets.

Rickets is not a disease which is hereditary, nevertheless the condition of the mother probably has some influence on its production. For it is a familiar observation that in large families whereof the children are born in quick succession, the younger members are often increasingly rickety; so that it would seem that quickly repeated pregnancies may induce in the mother a condition which predisposes the children to rickets. This may, however, be chiefly because the mother's milk will, in such cases, be less nourishing; or being deficient, is liable to be supplied by less suitable food: or, as is often the case among the poor, that the increasing family is attended with increasing narrowness of means, so that the younger children which are many, are less well fed than the elder children which were few. For it is a striking fact, that although in London rickets is one of the commonest diseases among the children of the poor; yet in the large manufacturing towns, where children are employed in factories, and thus soon become a source of income rather than of expense to the parents, rickets is extremely rare.[1]

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[1] Of 2,569 children employed in the Lancashire cotton factories, 203 had flat-foot, the prevalence of the affection increasing with the age of the children. See *Report to Local Government Board on Condition of Children employed in Textile Factories*, 1873, p. 48.

But rickets is not confined to the poorer classes; and among the wealthy it is not uncommonly the first children that are rickety. In such cases something is probably due to the highly artificial life often led by the mother.

But the most important factor in the production of rickets is certainly improper or insufficient food; next in importance to which may be placed a lack of pure air, of sunlight, and of warmth.

Hence the large proportion of rickety children among those brought up 'by hand,' who are therefore liable to the deprivation or adulteration of their proper nourishment, *milk*. The absence of a proper supply of milk for food is the commonest of all the causes of rickets. Oatmeal, cornflour, or other starchy foods, are given instead of milk; and are doubly harmful, inasmuch as they not only take the place of the proper food, but also impair the digestion of the infant, so that its nutrition is thus still further interfered with. Among the poor a very common cause of rickets is too long suckling; that is to say, the child is feeding upon milk which has lost much of its nutritive value.

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[1] Thus, among 2,569 children employed in the Lancashire cotton factories, a careful examination discovered only 31 showing any of the signs of rickets (excepting flat-foot, which was to be otherwise explained). See *Report to Local Government Board on condition of children employed in textile factories*, 1873, p. 51.

Treatment of rickets.

The treatment of rickets must be both constitutional and mechanical. It must be understood that the constitutional debility[1] is the essence of the disease; and that the deformities are accidents which vary with the variable influences upon which they depend. They are doubtless marks, but only accidental marks, of the disease, and may be entirely wanting. That is to say, rickets may exist without deformity; and on the other hand, the deformity may persist when the disease has passed and gone, so that we may have to treat, not rickets, but its results.

Bearing in mind, then, the causes of rickets, it will be manifest that for its treatment it is of the first importance to secure appropriate feeding; to remember that milk is the best of all antidotes to rickets, and that no milk has the same nutritive value to the infant as its mother's. If, therefore, the mother is not able entirely to nourish the infant, it is far better that she should suckle it partially than not at all. If, however, the child must be brought up by hand great care should be taken to ensure the proper digestion of the milk given.

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[1] See Jenner, *Medical Times and Gazette*, 1860, vol. i. p. 259.

Rickets may sometimes be seen in children who have had their milk in too great quantities, or in too concentrated a form, and have thus been unable to digest it. When rickety children cannot digest a sufficient quantity of milk, a small quantity of pounded raw meat is an excellent addition to the food.

Of medicines for the remedy of rickets, cod-liver oil is by far the most valuable ; it is, indeed, almost a specific, so that it is worth while to take whatever pains may be necessary to enable the rickety child to digest it. It should of course be given directly after food. Iron is also very useful, especially in the later stages of the disease.

Warm clothing, and plenty of fresh air and sunlight are important aids ; and a visit to the sea-coast is often of great benefit.

Cold or tepid baths are serviceable tonics ; they should be of brief duration, and followed by plenty of friction. The douche is an especially useful form.

Mechanical treatment.

The mechanical treatment of rickets is *preventive* and *remedial.*

Much may be done for the prevention of rickety deformities. It is important that the rickety infant should be as much as possible in the recumbent position ; not only to obviate the tendency to bowed spine, and the stretching of the muscles and ligaments which that implies, but also to ensure free respiration. If the child is nursed in the sitting position, the weight of the head bows forward the cervical and upper dorsal spine, and greatly interferes with the expansion of the chest. The child should therefore not be carried about in the nurse's arms, but upon a small mattrass pillow, which may be conveniently supported by a sling passing over the nurse's shoulders.

When the time for independent locomotion comes, care must be taken that the child does not push itself along nor try to stand, while the bones are still soft, otherwise bone curvatures will inevitably occur. Fortunately, rickety children are usually backward in their attempts at locomotion; but if there is any difficulty in preventing these, it is necessary to apply splints to the lower limbs in such a manner as to make locomotion impossible.

For this purpose well-padded wooden splints should be applied from the hips to about three inches below the feet, on the outer side of the limbs. The upper ends of the splints should be connected by a waistband, and they should be bandaged lightly to the legs as far as the knees. If any curvature of the tibiæ has taken place, this may be remedied at the same time that the child is kept off its feet, by the splints; but in this case there should also be an inside splint from the knee downwards to a distance not quite correspondent to the outer splint. The reason for this variation in the position of the lower ends of the splints is that, if they extend to the same distance below the feet, the child will sometimes manage to stand upright upon their level ends, and may thus have a painful fall. The splints should of course be removed at night, and the child encouraged to kick about and exercise its limbs before the splints are replaced in the morning.

In some cases of rickets the debility seems to fall more upon the muscles and ligaments than upon the bones; and in such children we may see antero-posterior curvature of the spine, or in older children lordosis (both of which it will be observed are exaggerations of the normal curves), without any bending of the long bones.

Treatment of rickety curve of spine.

The recumbent posture is absolutely necessary for the remedy of both of these spinal deformities, and must be maintained in young children by the means above indicated; while older children must be kept lying down either entirely or for a definite portion of the day, according to the severity of the disease.

No kind of apparatus of support answers the same purpose as the recumbent posture; in cases therefore which are not so severe as to require absolute recumbency, the best plan is to allow the child to be up twice or thrice in the day for a sufficient time to exercise without fatiguing the muscles, and to lie down for the rest of the time.

This is far better than to allow the child to go about with a 'spinal support.' Such appliances are in my opinion never thoroughly efficient, and have the disadvantage of interfering with the natural action of the respiratory and other muscles, and with the expansion of the chest, besides giving the child a certain amount of weight (often not inconsiderable) to carry about; objections which apply to the plaster of Paris and other 'jackets,' as well as to metal instruments.

Another reason for keeping the subjects of severe rickets completely recumbent, is that by so doing, pelvic deformities and the yielding of the abdominal parietes above described are thus prevented, and even the changes in the shape of the thorax occur to a less extent.

Treatment of curvature of

To remedy the curvature of the long bones, light well-padded wooden splints, carefully proportioned to bones.

the size of the limb, should be used. They should be placed upon both surfaces of the limb, and kept in position by an evenly applied bandage.[1]

A good deal of care is necessary in their application, especially during the first part of the treatment, and until the child becomes accustomed to their presence. The nurse must be systematically instructed in the method of bandaging; and a daily careful inspection made of the skin, to ensure that no part of it is suffering from undue pressure.

Bending of the bones of the forearm may be remedied by splints upon its upper and under surface, which should extend only to the palm of the hand, and leave the fingers free.

To the lower extremity splints should be applied on the outer and inner surface of the limb.

In severe cases the splints should be worn both night and day; and when removed for the morning and evening bath, they should be left off for a short time, and the muscles exercised either by active or passive movements. As the limbs become stronger the splints may be left off at night; and finally the child may be allowed to walk with the splints extending to the level of the soles of the boots. In slighter cases it is sufficient from the commencement of the treatment, that the splints should be worn in the day only.

Leg splints, when used upon children who are walking, are apt to become displaced unless in some way fixed to the boot; and it is therefore necessary to have a light angle-iron attached to the lower end of the outer splint, the horizontal arm of which fits into a socket which is inserted into the heel, or may be screwed on to the under surface of the 'waist' of the sole of the boot.

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[1] The best material for the bandage is domett.

Fracture. When the long bones are greatly bent, and they are not sufficiently soft to allow of straightening by the use of splints, an attempt may be made to fracture them, so that union may be obtained in an improved position. If this can be accomplished by a moderate degree of force, so that the soft parts are not materially injured, a very good result may be thus obtained. In this operation care must be taken to grasp the limb

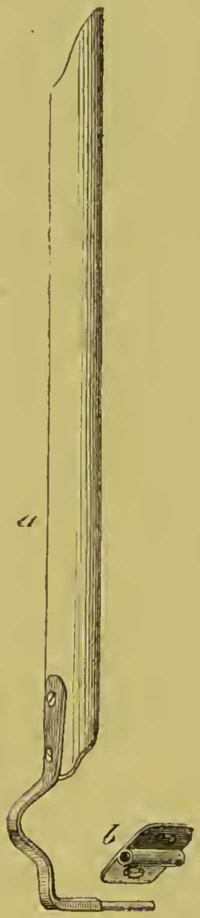

FIG. 23.—SPLINT, WITH ANGLE IRON AND SOCKET, FOR THE TREATMENT OF BOWED-LEGS.

a. Wooden splint with angle iron at lower end.
b. Socket to be screwed to under-surface of boot.

well within the neighbouring joints, so that in applying the necessary force, no injury is done to the joint structures. The limb may be put up in plaster of Paris immediately after the fracture, and union is usually rapid and sound.

Osteotomy,

When, however, the bones have attained a greater degree of hardness than will admit of their being fractured by moderate force, they can only be properly straightened by osteotomy. The bones most commonly requiring this treatment are those of the leg, and in such cases the most satisfactory operation appears to me to be the removal of a wedge of bone from the convexity of the curve.

The operation should be performed antiseptically. A longitudinal incision being made over the convex surface of the bone, a chisel[1] is introduced into the wound, and then turned across the axis of the bone, and with a mallet driven through about three-quarters of the thickness of the shaft ; it is then withdrawn, and the section repeated in such a manner as to remove a wedge of bone of sufficient size to allow of the limb being straightened with a slight amount of force.

The fibula is then either broken or divided, the wound closed, and the limb placed in splints or plaster of Paris.

In less severe cases, the division of the shaft of the bone, without the removal of any portion of it, is sufficient to remedy the deformity.

It is seldom necessary to divide the thigh-bone for the remedy of bowed-legs ; the straightening of the tibial curves is usually sufficient, and is, moreover, often followed by considerable improvement in the condition of the femora.[1]

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[1] Mr. Marsh, who has published some very satisfactory cases of osteotomy in rickets, prefers to divide the bone with a saw. See *Med. Chir. Trans.*, vol. lvii. p. 145. My own experience is in favour of the chisel.

Treatment of knock-knee.

The treatment of knock-knee varies with its severity and duration; but it is the latter which should chiefly influence us in the selection of the method to be adopted. A severe case of short duration is much more easily remediable than even a less severe one in which the deformity has occurred more gradually. The changes in the articular ends of the bones are in proportion to the duration of the deformity; and when the rapid yielding of the ligaments has allowed knock-knee to be produced in a short space of time, the limb can be straightened with corresponding rapidity and ease. I do not mean that in such cases the duration of the treatment will be less; on the contrary, it will have to be maintained for a long period, but no operation or other severe methods are needful even for bad cases of knock-knee wherein the deformity has been quickly produced.

Mechanical treatment.

In all cases, then, of knock-knee, in which the deformity has existed but for a short time, the patient should be kept at rest, and an outside splint applied from the waist to the feet. That part of the bandage which fixes the knee should be of india-rubber, and should extend from a few inches below, to the same distance above, the joint. After a time the patient may be allowed to go about with splints on, but not permitted to flex the knees. For this purpose the splints should be attached at their upper extremity to a pelvic band, by means of a slightly bent rod with a moveable joint at the hips; and at the lower end they should be fixed to the boot by a metal socket. As the ligaments gain strength a slight amount of flexion of the leg may be allowed, by introducing into the splints a joint of limited motion, at a point corresponding to the knee ; a plan I believe first suggested by Mr. Cæsar Hawkins. Finally, a greater freedom of movement may be permitted, but lateral support should not be dispensed with for long after the deformity is overcome. There is a great tendency to relapse when the treatment of knock-knee is discontinued, so that the case should be carefully watched for any symptom of recurrence of the distortion.

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[1] See Mr. Marsh's remarks on his fourth case, *Op. cit.*, p. 153.

During the later stages of the treatment light iron supports may be substituted for the wooden splints ; but in the earlier part, the latter are much the more efficient. The cold douche to the knee is a valuable aid, and care should be taken to keep the limbs warm.

Constitutional treatment also must by no means be neglected. The subjects of knock-knee usually show other signs of debility, and much benefit is derived from ferruginous tonics.

Instances of this deformity, however, will be met with in which, from its long duration, changes have occurred both in the bones and the surrounding tissues, which prevent its being remediable by the measures above described.

If the inward yielding of the knee is very great, any attempt to straighten it will be found to make prominent the fascia lata on the outer side of the joint as it passes to its insertion on to the tuberosity of the tibia and the head of the fibula ; the biceps tendon may also be felt more posteriorly, stretched tightly across the angle.

To severe cases of this kind it would be difficult to apply splints efficiently, and for these it is better to have an instrument made to fit the limb accurately, and so jointed at the knee that the limb can be gradually brought thereby to a right line. The apparatus that I recommend for this purpose consists of a metal rod adapted to the outer side of the limb, jointed at the knee, and fixed below to a foot piece, or boot, and above to a pelvic girdle. Attached to this rod are two leathern collars moulded to fit the thigh and leg respectively ; and on its outer side is a screw whereby extension can be gradually made. If the contraction of the fascia lata and the biceps appears to be a serious impediment to the straightening of the limb, those structures should be subcutaneously divided ; but as a rule contracted tendons in recently acquired deformities easily yield to gradually applied extension ; and if the contraction can be thus overcome, it is better to avoid the operation, which weakens the knee-joint on its outer side.

In some cases, however, the chief obstacle to the correction of the deformity is obviously the hypertrophy, and consequently altered level, of the inner condyle ; and to these the operation of detaching the condyle and pushing it upwards to a proper level may be rightly applied. This operation has been carried out with antiseptic precautions in various ways.

Operations for knock-knee.

Mr. Annandale,[1] in 1875, not only divided but removed the condyle, by an operation which involved the free opening of the joint and division of the ligaments.

A great improvement upon this was the operation, first practised by Dr. Ogston [2] in 1876, of subcutaneously sawing through the condyle, which was then pushed upwards and allowed to unite at the natural level. This is accomplished by introducing an

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[1] *Edinb. Med. Journ.*, July 1875, p. 18.

[2] *Ibid.*, March 1877, p. 782.

Adams's saw through a small wound made with a tenotome over the lower end of the inner side of the femur, just above the condyle. The line of section should fall to the inner side of the crucial ligaments, and when the condyle is nearly sawn through and the popliteal surface is approached, the saw is withdrawn, and the condyle broken off by forcing the limb into the straight position.

In 1877 Mr. Chiene[1] cut through the condyle with a chisel, and removed a wedge-shaped piece of it; and in 1878 Dr. Macewen[2] endeavoured to do this without opening the joint, by stopping short of the articular cartilage in the removal of the wedge of bone. The sides of the gap thus created are pushed together by the forcible straightening of the limb. Dr. Macewen had previously attained the same object by cutting out a wedge of bone transversely from the shaft of the femur, slightly above the epiphysial line; but the operation which he now recommends,[3] and which he has successfully practised in numerous cases, is the simple transverse division of the femur for about the inner two-thirds of its thickness, and the fracture of the remaining third by the forcible straightening of the limb.

The operation is a simple one. A longitudinal incision is made through the soft parts down to the bone over the inner side of the femur, of sufficient size to easily admit the blade of a chisel. This incision should be over 'the point where the two following lines meet, a line drawn transversely from the upper border of the patella when the limb is in the extended position; and a line drawn longitudinally about half an inch anterior to the spine for the insertion of the adductor magnus tendon.' 'Through this wound the osteotome is introduced longitudinally, until it comes into contact with the bone, when it is turned transversely. Its lower border—the one which is for the time posterior—is made to glide on the bone until it comes fairly behind, when the entire cutting edge of the osteotome is applied, and the instrument is made to pass in a direction from behind forward, and toward the outer side. From this position it is made to move forward along the inner border, until it comes to the anterior surface, when it is directed from before backward and toward the outer posterior angle of the femur. In keeping on these lines there is no fear of injuring the artery.' 'When the operator thinks that the bone has been sufficiently divided, the osteotome is laid aside, a sponge saturated in 1 to 40 carbolised watery solution is placed over the wound, the surgeon holding this in one hand, which he at the same time employs as a fulcrum, while the other hand grasps the limb lower down, and gives it a quick jerk inwards, when the bone will snap, or bend, as the case may be.'[1]

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[1] *Brit. Med. Journ.*, Oct. 13, 1877, p. 529.

[2] *Ibid.*, May 3, 1879, p. 656.

[3] *Ibid.*, Oct. 13, 1879, p. 607.

In this operation the diaphysis of the femur is divided at a level of about an inch above the epiphysis; that is, at a point corresponding with a line drawn across the bone, half an inch above the upper margin of the patella when the limb is in the extended position.

The limb may be placed for the operation either upon its outer side, or in the extended position, and Dr. Macewen recommends that it should rest upon a sand pillow of about a foot square, which is a convenient means of steadying it. Dr. Macewen has also given some very useful directions concerning the manufacture of the chisel (or osteotome, as he prefers to call it) to be used in such operations.[1] This is a matter of considerable importance, for it is much easier to control and feel the direction in which the edge of the chisel is travelling, when it is made as Dr. Macewen recommends, in one piece, than if it is fixed to a wooden handle. I have, moreover, experienced the annoyance of having half an inch of a chisel break off in the substance of the condyle, in consequence of its being of brittle metal.

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[1] Dr. Macewen in *Brit. Med. Journ.*, May 3 and Oct. 13, 1879

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[1] 'They were made from Stubbs's finest five-eighths steel, forged at a low heat; tempered by raising the instrument to a cherry-red heat, dipping it in oil, and then plunging it into water until cold; next polished, and about an inch of the chisel, measuring from its cutting edge, having its temper drawn back by raising it to a copper-yellow colour with purple spots (probably a temperature of 520° F.). In these instruments only a small portion of the chisel, embracing the cutting edge, is raised to a great degree of hardness; the remainder of the blade is comparatively soft, so as to avoid the possibility of snapping. Though this is applicable to all the chisels, it is particularly so to the finest, especially when used in cases where the bone is very thick, and the instrument has to be deeply inserted. A good material for testing the edge of the instrument is the thick part of the hough-bone of an ox. If one finds that the instrument will neither turn nor chip in penetrating such a bone, it may be concluded that it is well suited for cutting any human bone. These instruments stood this test. I have found them to possess the quality of great hardness, combined with toughness, and hitherto, although used on some very hard and dense human bones, they have neither turned nor chipped. The handle and the blade form one piece. The handle is octagonal, and I prefer it to the oval or cylindrical, as it gives a better grip, and enables the operator to detect more readily any deviation which the instrument may assume. The top of the chisel is furnished with a rounded projecting head, against which the thumb of the operator rests as he steadies the instrument; it also serves as a support, whereby the instrument may be gently levered out of the section. The figures 1 and 2 are placed near the head on the surfaces which correspond to the thickness of the blade, in order that they may serve as a means of distinction when the blade is obscured in the tissues. The borders of the blade are marked with half-inches, the figures being extremely light. The thickness of the bone can be ascertained in many cases, and thus the distance to be penetrated can be predetermined. The figures on the border of the instrument point out the depth to which it has penetrated, and thus serve as a guide. They are finely polished, not for appearance, but because the finer the surface the less opportunity will organic matter have of becoming adherent, and afterwards decomposing.'—*Brit. Med. Journ.*, May 3, 1879, p. 656.

Mr. Barwell has performed a somewhat similar operation, upon the outer side of the femur; in addition to which he also divides the tibia, so that his treatment of genu valgum involves an osteotomy of both thigh and leg.

Of these two operations that of Dr. Macewen seems to me to be much preferable; and although he has in a few very aggravated cases divided the tibia as well as the femur, he admits that section of the tibia is hardly ever necessary, and conduces more to the symmetry than to the usefulness of the limb.[1]

In May, 1878, Mr. Reeves drew attention to a modification of Dr. Ogston's operation which he had practised, and which consists in loosening the inner condyle by means of a chisel, instead of cutting through it with a saw. 'It consists in first flexing the knee, so as to render the outline of the condyle prominent and to pull down the supra-patellar pouch of synovial membrane. The thigh and leg being steadied by assistance, a scalpel is introduced obliquely just above the internal tuberosity, the soft parts divided, and a graduated chisel, on which the depth of the condyle and soft parts has previously been ascertained, is passed beside it. The condyle is then loosened, but not separated, and the chisel-cut should only extend to about one-eighth of an inch from the articular surface of the cartilage. The limb is then forcibly straightened, a small pad of lint dipped in carbolic oil is applied, and a plaster of Paris bandage put on. On the tenth day the bandage is removed, and it will be found that the patient can partially flex the knee. Gentle passive motion is resorted to, and the same plaster splint reapplied, being fixed with an ordinary bandage. Passive motion is continued daily until complete flexion is reached, and the patient is allowed to walk with crutches in fourteen days after the operation. In five or six weeks usually the cases may be discharged.'[1]

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[1] *Brit. Med. Journ.*, Oct. 18, 1879, p. 608.

It is claimed for this operation that the knee-joint is not necessarily interfered with ; but though I think it has several advantages over Dr. Ogston's method, I am unable myself to believe that this is one of them. It seems to me to be impossible to push up the hypertrophied internal condyle to the natural level, without fracturing the cartilage ; and although I believe it to be both possible and desirable to arrest the progress of the chisel before it reaches the articular cartilage, yet I feel sure, from observations upon the dead subject, that the cartilage undergoes fracture when the condyle is pushed up by the straightening of the limb. Moreover, if the rounded shape of the articular surface of the femur is borne in mind, it will I think be obvious that it must be, to say the least, extremely difficult to carry an instrument like a chisel to within one-eighth of an inch of one part of the cartilage, without encroaching upon it at another ; an opinion which, I think, will be shared by anyone who will try the experiment upon the dead subject, and then verify the result of his attempt.

Nevertheless, this is in my opinion the best of the operations upon the bone for the relief of knock-knee ; and in those cases wherein the hypertrophy of the condyle is the chief factor in the deformity, is followed by excellent results.

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[1] *Clinical Society's Trans.*, vol. xii. p. 32.

When carried out, as it should be, with antiseptic precautions, it is usually attended with little or no constitutional disturbance, and often there is not even any effusion into the joint. The absence of this last symptom has been adduced as evidence that the joint was not interfered with ; but the argument is not good, for the knee-joint may be freely opened antiseptically (as for the removal of loose cartilages) without any effusion following the operation. Fig. 24 shows the position at which the section of the condyle should be made.

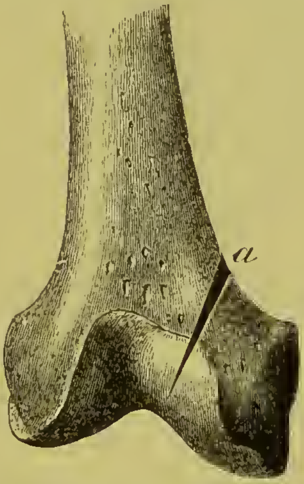

FIG. 24.—LOWER END OF THE FEMUR, IN A CASE OF GENU VALGUM WITH HYPERTROPHY OF THE INNER CONDYLE.

a. Position at which section of condyle should be made.

I have been careful to limit my recommendation of this operation to the cases in which the enlargement of the condyle is the chief obstacle to the cure of the deformity ; and I would point out, moreover, that in cases in which there is much elongation of the ligaments in addition to the hypertrophy of the condyle, the result of the operation, at any rate at first, will be much less satisfactory, and the joint will require support for a long time after the bone is quite firm. In such cases the operation upon the bone allows the deformity to be at once remedied; but when the patient begins to walk the laxity of the ligaments will allow the recurrence of considerable inversion, unless precautions are taken to prevent it. I would emphatically protest against the assumption that all cases of knock-knee depend upon one cause, and must therefore be submitted to the same treatment; and with regard to the particular operations that I have described, we are still in want of the most essential evidence upon which to base an opinion of their relative merits, for we have as yet no comparative observations upon the ultimate utility of limbs so treated.

Treatment of flat-foot.

Flat-foot must be treated upon the same general principles as knock-knee; for, like that deformity, it is often but a part of a general debility. When it occurs, as it often does, in rickety children, the cure of the rickets will be an essential part of the treatment; and when it arises later in life other evidences of debility must be carefully looked for. The cure of flat-foot in young and growing subjects is almost always assisted by the administration of iron, to which cod-liver oil may often be usefully added.

In severe and rapidly increasing flattening, no remedy is comparable to the maintenance of absolute rest; indeed, but little can be done for such without the aid of rest. A splint should be bandaged to the inner side of the leg and foot, so as to ensure rest and to overcome any eversion of the foot; it should be worn night and day, but removed daily for the application of the cold douche to the foot, and for the readjustment of the bandage. An ordinary Cline's splint, such as is used for fractured leg, answers very well; but a still better appliance is a straight splint, to the lower end of which is attached a steel spring, with a pad to fit into the arch on the inner side of the foot. The spring tends to draw the foot inwards, and the pad to push up the arch which has become flattened (fig. 25).

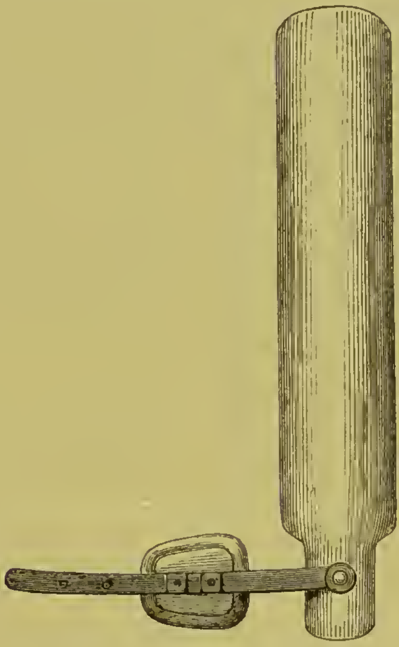

FIG. 25.—SPLINT FOR FLAT-FOOT.

When the arch has been restored by this means, the patient may begin to take gentle exercise, the amount and duration of which is gradually increased. This should always stop short of fatigue; and it must be remembered that while moderate walking does good, standing without movement always does harm.

When walking is allowed, a special form of boot must be worn, and for a few months the splint should be applied at night.

The boot for valgus has within it an india-rubber pad, which should correspond in shape, size, and position to the natural arch of the foot. That is to say, the pad should be fixed to the inner side of the boot, and extend half way across the sole ; it should be convex from before backwards, and from side to side, and should gradually diminish in thickness from the inner towards the outer side of the sole.[1] The heel of the boot should also be slightly thicker on the inner side, and increased firmness can be given to the inner side of the boot by the addition of a triangular piece of stiff leather over the ankle. It is sometimes desirable to add to this, lateral supports, to extend up the leg and prevent eversion.

In slight and commencing cases the 'valgus-boot' is the only mechanical aid required, and in many instances the support thereby given to the yielding arch at once relieves all the discomfort due to the deformity.

The cold douche is of great value in the treatment of flat-foot. It should be used once or twice daily, and may be administered with advantage to children on their return from the morning and afternoon walk, as an antidote to the stretching of the ligaments which the walk involves ; it ought always to be followed by friction.

In all cases of weakness of the tissues of the foot it is of great importance to keep the part warm, especially when the mechanical treatment involves a lack of exercise ; and for this purpose straw soles worn inside the boots, wash-leather socks, and other such aids are not to be despised. Boots with elastic spring sides are to be avoided ; indeed, they are to be condemned even for the healthy, and much more, therefore, for those with weak feet. These boots are less fashionable than they were a few years ago, when it was common to see a sore produced over the tendon of Achilles by the constant grip of the upper margin of the boot ; besides which they tend, by interference with the circulation, to produce cold feet and varicose veins, and by thus impairing the nutrition of the tissues to lead to flat-foot and weak ankles.

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[1] The valgus pads may also be attached to a separate sole of thin leather, which can be placed in an ordinary boot.

It can scarcely be needful to say that in the treatment of flat-foot the division of tendons is entirely uncalled for.

CHAPTER VIII.

LATERAL CURVATURE OF THE SPINE.

Scoliosis, or lateral curvature of the spine, is not usually indicative of any disease of the bones, but is rather an alteration of position than of structure. The spine exhibits more or less lateral deviation from the straight line, which is accompanied by a rotation of the bodies of the vertebræ upon their own axes.

Doubtless in advanced stages, and after long duration of the deformity, structural changes are found to have occurred ; but these are the result of the persistent maintenance of an unnatural position, and although often of grave importance, are not essential.

Causes of lateral curvature.

The causes of the deformity are various, and it is necessary for its successful treatment that they should be clearly understood.

Lateral curvature is produced by something which disturbs the balance of the two sides of the body, and causes an inclination to one side or the other. Most commonly this is muscular debility. The muscles which should hold the spine erect are weak and unequal to their work ; they soon become fatigued, and to relieve this fatigue the weight of the body is thrown first towards one, and then towards the other side, so that each set of muscles is alternately relaxed. This is frequently accomplished by standing on one leg, or when sitting, by resting on one elbow with the shoulder lowered on the same side. As the habit becomes confirmed, there is a tendency to rest more often on one side than on the other; until it becomes natural, whenever fatigue is felt, to throw the weight on to that side of the body.

In this manner is gradually developed a lateral curve of the spine; one set of muscles being habitually relaxed, while their opponents are kept in a state of tension.

The rotation of the spine.

But the attachments and direction of action of the chief spinal muscles are such, that if the muscles of the two sides are in unequal action, there necessarily results a rotation of the vertebræ, which therefore is an essential concomitant of this kind of spinal distortion. It is this twist of the spine, in addition to the lateral curve, which has led to the application to such cases of the terms 'rotatory curvature,' 'rotary-lateral curvature,' and 'contorted spine;' but if it be borne in mind that, with the exception of cases depending upon intra-thoracic disease, all lateral curvatures imply the existence of rotation, it seems hardly worth while to depart from the usually accepted designation.

The description given above, indicates the mode of origin of a very common form of lateral curvature, which is most frequently met with in growing girls, and in which the curve usually has its concavity to the right in the lumbar region, and to the left in the dorsal.

Probably, also, a good many such cases have their origin in the awkward positions in which children often sit during a large part of their school hours, in consequence of the badly arranged seats and desks at which they are obliged to carry on their studies; conditions frequently rendered more harmful by errors in the arrangement of the light.

Short-sighted children are especially prone to this form of curvature, in consequence of bending over their work, so as to bring their eyes sufficiently close to it. The approximation of the face to the object renders difficult the proper illumination of the latter; and to obtain all the light possible the spine is twisted, and one or other of the shoulders depressed.

I have seen the same result produced by the use of unsuitable spectacles; so that it is desirable to enquire into the condition of the sight, when seeking the cause of lateral curvature.

Attention has recently been drawn to this subject by Mr. Liebreich in two lectures upon 'School Life in its Influence on Sight and Figure,'[1] wherein will be found some useful suggestions for the prevention of the evils alluded to.

In a similar manner, the deformity may be produced by carrying heavy weights upon the shoulder or arm, as in nursing a child. When the weight is borne upon the head, so that the muscles of both sides of the body are equally exerted, no such curvature takes place.

Lateral curvature is also occasionally seen as one of the manifestations of the disease ordinarily called 'hysteria,' or 'neuro-mimesis;' and in such cases is the result of spasmodic contraction of one set of the muscles acting upon the spine.

Another cause of lateral curvature is an inequality in the length of the lower extremities, which may arise in various ways; as, for instance, in flat-foot, or knock-knee, where the two limbs have yielded unequally; or in hip-disease, from absorption or displacement of the head of the bone; or in disease of any of the joints of the lower limb, causing the affected part to be drawn away from the ground and the weight to be thrown on the sound limb; or even from tender corns acting in the same way; or from fracture of the thigh or leg, or from paralytic wasting.

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[1] Published by Churchill, London, 1878.

Primary and secondary curves.

The curve will affect first the upper part of the spine in cases of wry-neck, in which the weight of the head is thrown towards one side; and in those instances arising from carrying weights on the upper extremities, or in which the balance has been disturbed by amputation of the arm. Whereas, when the distortion originates in defects of the lower extremities, the lumbar curve will first appear. But wherever the first or primary curve may occur, there is soon developed a secondary curve or curves, necessary for the maintenance of the equilibrium of the body. The most common primary curve is doubtless in the lumbar region, but the compensatory dorsal curve is often that which first attracts attention.[1]

Lateral curvature following pleurisy.

Another form of lateral curvature, which must be distinguished from the preceding, is that due to shrinking of one side of the chest after pleuritic effusion. This is a purely lateral curve, affecting the entire dorsal region, and unattended with the rotation of the bodies of the vertebræ seen in the other forms. It occurs in consequence of the lung being bound down by pleuritic adhesions, so that it cannot expand as the fluid in the cavity of the pleura is removed. The chest wall must thus fall in, and as the ribs sink down to the contracted lung, a corresponding spinal curve takes place, which is subsequently made more apparent by the enlargement of the sound side of the chest, which has to do double duty.

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[1] It is convenient to use the terms primary and secondary curves, as indicative of the origin of the deformity in a particular part of the spine, but as Mr. Adams has pointed out, the formation of the two curves is probably almost simultaneous.

Symptoms of lateral curvature.

The most notable symptom of lateral curvature, and that for which advice is usually first sought, is an undue prominence of one shoulder or hip. The person so affected is often thought to have disease of the hip or shoulder, and spinal deformity is not suspected until revealed by the surgeon's examination. Any such prominence or obliquity of the scapula or hip should always lead to a careful examination of the spine.

For this purpose the patient should remove the clothing as far down as the iliac crests, and be made to stand with the feet level, the arms hanging down, looking straight before him with the head erect and the point of the chin exactly over the sternal notch. With the person in this position, the trunk should be carefully scanned, and the situation of the spinous and transverse processes noted, as well as any diminution or flattening of the natural antero-posterior spinal curves ; the respective level of the scapulæ and iliac crests should next be observed, and also any difference in the position and curve of the ribs on the two sides ; finally, the condition of the spinal muscles on each side, and of the trapezius and latissimus dorsi, should be compared. The patient should then be directed to bow slowly forwards, and whilst keeping the lower limbs rigid, to endeavour to touch the toes with the extended hands. During this movement, any rotation of the vertebræ may be seen, or felt with the hand on the spine.

It must be remembered, in such examinations, that the position of the spines of the vertebræ is not a safe guide to the amount of lateral curvature; for there may be great rotation of the bodies of the vertebræ with comparatively slight deviation of the spinous processes. But such rotation can be detected by observing the change in position of the transverse processes; which can be felt prominently on the side corresponding to the convexity of the curve, but are carried away from the surface on the side of the concavity: also by contrasting the positions of the scapulæ; which, although they may not be materially altered in level, will be unequally prominent, that on the side of the convexity of the spinal curve being carried backwards with the ribs.

In slight and early cases of lateral curvature, the curve can be made to disappear by placing the patient in the prone position, or by suspension from the head and upper extremities; in this stage there is only change of position, not of structure. But when the deformity has existed for a longer time, the parts concerned have undergone structural alterations of an important character, which render the treatment much more difficult, and the cure often impossible.

Hence the necessity for discovering and treating the disease in its earliest stage, and the folly of neglecting such cases under the popular delusion that the person may 'grow out' of the deformity. It cannot be too much insisted upon, that the tendency of all such deformities is to increase when they have once been started; and unless measures are taken to prevent its progress, the very presence of a slight curve is one of the most potent influences in its development. Everyone knows that while a column is still upright, it will bear additions to its superincumbent weight which, if it were but a little bent, would speedily bring it to the ground.

The sense of fatigue and consequent muscular yielding, accompanying a slight spinal curvature, soon tend to its increase; so that by the neglect of such cases in their early stages, the most valuable time for their treatment is often lost.

Structural changes.

If, then, the deformity has passed into the advanced stage, certain structural changes will be found to have taken place, the existence of which will depend chiefly upon the duration of the deformity, although of course they will be more marked in the severe than in the slighter cases.

The bones.

The bodies of the vertebræ, besides being rotated towards the convexity of the curve, are subjected to increased pressure in the concavity of the curve, so that both the bones and the invertebral discs gradually assume a wedge-like form. The compact layer of the bodies of the compressed vertebræ becomes somewhat thicker and denser, and small processes of compact tissue may sometimes be seen passing from the body of one vertebra to that of the next, giving an increased rigidity to the compressed part.

The facets of the articular processes are increased in size by the rotation of the bones, the processes on the concave side of the curve are shortened by absorption, and in extreme cases ankylosis of these joints may occur.[1]

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[1] Mr. A. Shaw considers this alteration in the articular processes to be the cause of the rotation; but I cannot but think that it is really the effect of the rotation which, as will be subsequently explained, depends upon muscular action.

Mr. Adams also (*Lectures on Curvature of the Spine*, 1865, p. 124) considers that these changes in the articular facets are present from the commencement of the curvature—an opinion which is chiefly based upon the slight amount of movement which he considers is normally possible

The spinous processes are curved to a varying extent, in consequence of their not following in an equal degree the rotation of the bodies. Thus their apices may be not far removed from the median line, although the bodies of the vertebræ are rotated in two opposite directions in the upper and lower part of the spine. The apices being comparatively fixed points, the spinous processes will be bent towards the concavity of the curve, and their direction will therefore be reversed in accordance with the twisting of the lumbar and dorsal vertebræ. It will thus be seen that the position of the apices of the spines is a very fallacious guide in the estimation of the amount of spinal distortion.

Ligaments.

In the majority of cases the spinal ligaments display no important changes, beyond a certain amount of relaxation or weakness, which they share with those of the other joints. But in long standing and severe cases, the ligaments connecting the articular processes on the concave side are found atrophied, or even in some parts entirely absorbed, so that the bones that they should unite are welded together.

Muscles.

It is of much importance to notice the condition of the muscles in lateral curvature, for it is to inequalities of muscular action that the deformity is chiefly due.

It will be found that the muscles on the concave side of the curve are shortened and *relaxed*, and consequently thick and bulging; while those on the opposite side are stretched and *tense*.

Herein it seems to me is to be found the explana-

in these joints. But their shape and structure, each with its articular cartilage, synovial membrane, and capsular ligament, certainly show them to be adapted to some amount of rotatory movement, and this would be increased if the ligaments were weak and yielding.

tion, not only of the lateral curvature, but also of the rotation of the vertebræ which accompanies it.

If the attachments of the divisions of the great 'erector-spinæ' muscle are considered, it will be evident that when the muscle is in equal action on both sides, the spine will be held erect or arched backwards, as is seen in the erect gait of the pregnant woman. But if the muscle acts on one side only, as in lateral curvature, the ribs and transverse processes on that side will be pulled backwards, and the vertebræ thereby rotated ; while on the other side the spine sinks down in a lateral curve, so that the origin and insertion of the muscles are approximated, and the muscles are thus placed in a state of relaxation.

The most intelligible account of these muscles with which I am acquainted, is that given in Mr. Holden's work on Osteology, from which I will quote.[1]

'We now come to the great muscles of the spine, concerned in keeping the body erect. These are considered to be complicated. The truth is, they are very simple, provided the plan of the arrangement be borne in mind.' 'The vertebral groove on each side of the spine is occupied by the "erector-spinæ" and its prolongations, and also by the transverso-spinalis. The erector-spinæ arises by strong tendons from the crest of the ilium, back of the sacrum, and the spines of the lumbar vertebræ ; and subdivides into two masses of muscle. The outer, termed sacro-lumbalis, with its prolongations (musculus accessorius and cervicalis ascendens), is attached to the angles of the ribs. The inner, termed the longissimus dorsi, with its prolongations (transversalis colli and trachelo-mastoid), is attached to the transverse processes of the vertebræ.'

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[1] *Human Osteology*, by Luther Holden, F.R.C.S., Fifth Edition, revised by the author with the assistance of Alban Doran, F.R.C.S. 1878, p. 239.

It is evident that this muscle (the erector-spinæ) by its action on the ribs and transverse processes must rotate the vertebræ when acting only on one side ; but that when both sides are acting, the rotation movement is neutralised, and its action is to hold the spine erect, or to arch it backwards, as is seen in an exaggerated form in the opisthotonos of tetanus.

That this explanation of the vertebral rotation, and of the part played by the muscles in lateral curvature, is correct will, I think, appear the more probable from a consideration of the mode of origin of that large class of cases in which the spinal curvature is part of a general debility.

The spinal muscles becoming easily fatigued, are rested by throwing those of each side alternately into use, just in the same way as the lower limbs are rested by 'standing at ease,' with the weight of the body alternately thrown on to each leg. Now a muscle is rested by approximation of its origin and insertion, so as to relax its fibres. This is what is done on the concave side of the curve ; but this involves the stretching of those on the convexity, and this stretching is a source of irritation which stimulates the muscle to a contraction[1] which must result, as I have shown, in a rotation of the vertebræ.

It must be remembered, that though it is convenient for anatomical purposes to describe the erector-spinæ as one great muscle, it really consists of a great number of easily separable fasciculi, the fibres of which run obliquely upwards and outwards, to points of insertion at varying distances from their origin; so that there is no difficulty in supposing that one part of the muscle may be in action, while another part is at rest, as we know to be the case in the trapezius and other muscles.

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[1] For the tension of a muscle is, within certain limits, a stimulus to its contraction. See *Textbook of Physiology*, by M. Foster, M.C., M.D., F.R.S. 3rd ed., Macmillan, 1879, p. 81.

Another fact in favour of this opinion is that in those cases of lateral curvature depending upon contraction of the thoracic walls after pleuritic effusion, no such rotation occurs.

Dr. Dods,[1] in a book upon this subject published in 1824, drew attention to the rotation movement in lateral curvature, and ascribed it to muscular action; but he erroneously supposed the muscles on the *concave* side of the curve to be contracted, and therefore imagined that the bodies of the vertebræ were rotated towards the concavity of the curve.

It is well known also that M. Guerin has attributed the deformity to active muscular spasm, and has advocated and practised section of the muscles, as the appropriate treatment for its cure. It has been shown by the investigations of Malgaigne and others that this operation does more harm than good; and if the opinion I have advocated above as to the etiology of the deformity be correct, such treatment would be clearly unreasonable.

Mr. Adams, on the other hand, seems to me to be equally in error in disregarding the action of the muscles altogether; and with all due respect for one who has done so much for the advancement of orthopædic surgery, I cannot think that he is correct in stating that 'the spinal muscles are in the state of least activity in the erect position of the spinal column,' and that 'the functions of the spinal muscles are not to produce by active contractions any flexion or curvature of the spine, but essentially to regulate and limit the movements of the spine, and to restore the equilibrium of the spinal column when disturbed.'[1]

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[1] *Pathological Observations upon the Rotated or Contorted Spine*, by Andrew Dods, M.D. London, 1824.

Other muscles, besides those proper to the spine, may also no doubt assist in causing the deformity; their share in its production varying with the manner in which it has originated. For instance, Dr. Sayre, in his work upon disease of the spine, expresses his conviction that the serratus magnus, acting through the medium of the ribs, largely contributes to the formation of the dorsal curve;[2] and he also gives illustrations of a case of lateral curvature, in which the latissimus dorsi was tensely contracted.[3]

This case is instructive in its bearing upon the etiology of the distortion. It occurred in a man of great muscular development, whose left thigh was an inch shorter than the other; and whose employment consisted in carrying a large basket on his left shoulder and arm, the left hand resting upon the hip, and the right hand being thrown over the head, to hold the top of the basket. In this instance the spinal distortion was clearly not the result of debility of any kind, but of the tilting of the pelvis to bring the shortened limb to the ground, and of the irregular muscular action necessary to maintain the balance of the body in the position required by his employment. The latissimus dorsi had thus become structurally shortened; and it is easy to see that the division of this muscle, as practised by Dr. Sayre, would be likely to allow of some improvement in the deformity. Such a case of lateral curvature is, however, obviously of a quite opposite kind to those which originate in muscular debility.

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[1] *Lectures on the Pathology and Treatment of Lateral and other Forms of Curvature of the Spine*, by William Adams, F.R.C.S. London, 1865, p. 59.

[2] *Spinal Disease and Curvature*, &c., by Lewis A. Sayre, M.D. London, 1877, p. 92. See also *Orthopædic Surgery*, p. 390.

[3] *Spinal Disease and Curvature*, p. 118.

It is therefore very necessary for the treatment of lateral curvature to ascertain its mode of origin, that attention may be directed to the particular muscles concerned in its production.

Loss of symmetry of waist.

As a consequence of the approximation of the ribs to the ilium, and of the muscular contraction which has been described, there is a loss of the symmetry of the waist, which is a marked feature of lateral curvature. The flank sinks in on the concave side of the lumbar curve, so that the hollow of the waist is deeper and at a lower level on that side, whereas on the opposite side the hollow is raised to the level of the lower ribs, and an apparent prominence is given to the corresponding hip.

The scapulæ.

The dorsal curve, being the reverse of the lumbar, the relation of the scapulæ to each other is the reverse of that of the hollows of the waist; that is to say, the scapula is lowest on that side on which the bend of the waist is highest.

This will be seen by reference to fig. 26, in which the line A B runs through the dorsal curve, and shows the relative positions of the scapulæ, and the line C D through the lumbar curve, showing the different level of the hollows of the waist. The prominence of the left hip will also be noticed.

These changes in the condition of the spine and its muscles involve corresponding changes in the parts related to them.

Thus the pelvis alters its position coincidently with the formation of the lumbar curve. It becomes oblique, and undergoes a certain amount of rotation. **Pelvis.**

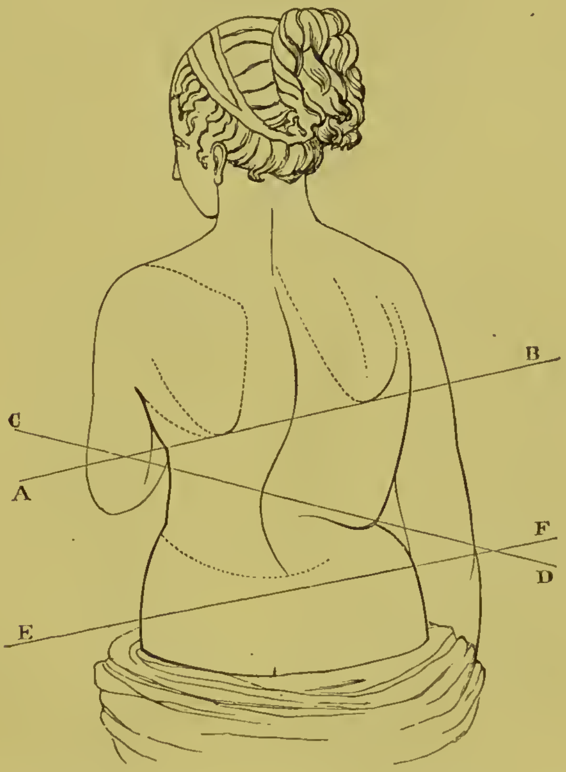

FIG. 26.—DIAGRAM OF A CASE OF LATERAL CURVATURE.

Showing the altered position of the scapulæ (line A B), of the hollows of the waist (line C D), and of the iliac crests (line E F).

On the side corresponding to the concavity of the lumbar curve, the ilium will be found on a higher level and somewhat posterior to its natural position ; while on the opposite side the reverse of this obtains, that is to say, the anterior superior spine is lower and more forward than it should be. In fig. 26, the level of the iliac crests is shown by the line E F, and it will be observed that more of the right ilium is seen than of the left, owing to the rotation of the pelvis towards the left.

Ribs.

The changes in the shape and position of the ribs are of grave importance, for they give rise to serious interference with the capacity and expansion of the thorax.

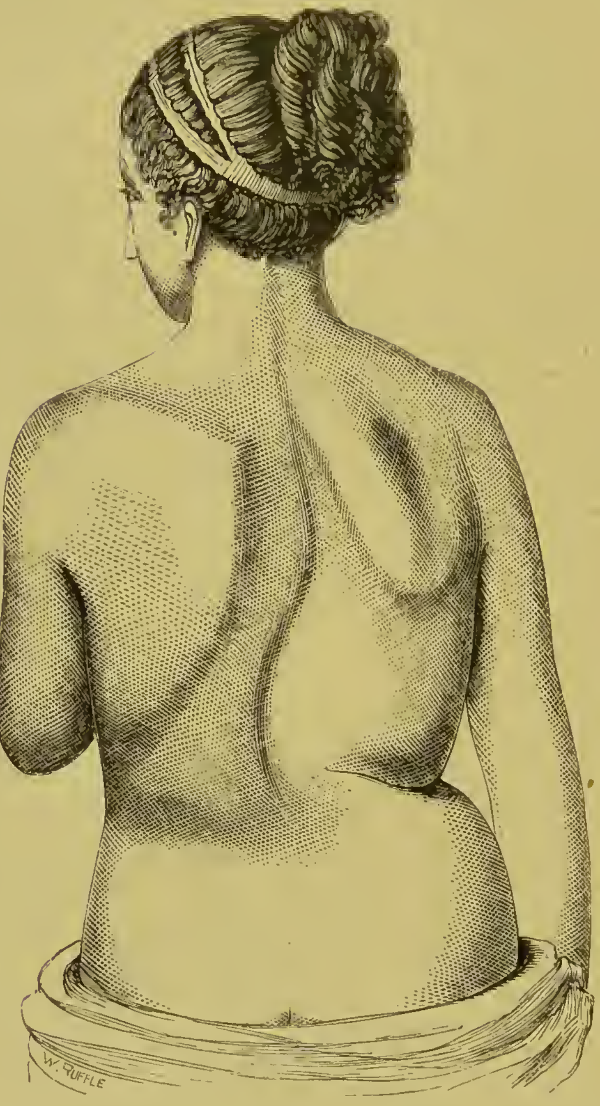

FIG. 27.—DRAWING OF CASE OF LATERAL CURVATURE.

Showing the altered position of the scapulæ and of the hollows of the waist. The recession of the right loin and the relative rotundity of the right side of the chest will also be noticed.

On the convex side of the dorsal curve, the ribs are carried backward by the rotation of the vertebræ to which they are attached, while they are at the same time raised and rendered more horizontal by the alteration in the level of the vertebræ resulting from the spinal

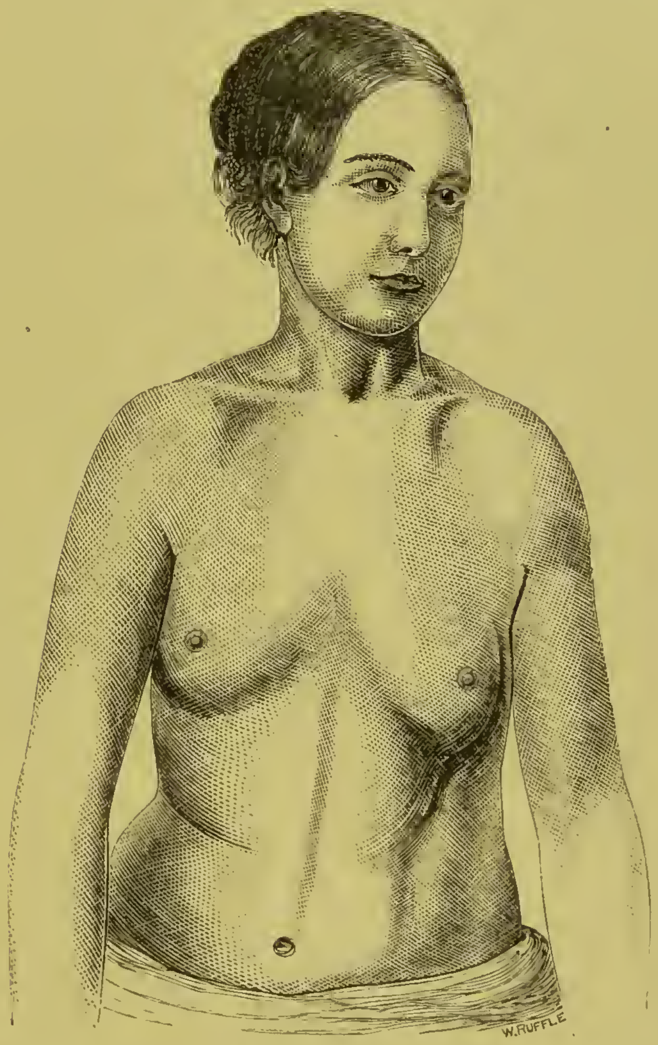

FIG. 28.—DRAWING OF A CASE OF LATERAL CURVATURE.
Showing the relative flattening of the right side of the chest.

curve. Thus the chest projects on this side, the angles of the ribs are prominent, and the intercostal spaces widened. The scapula on this side will also be on a higher level and its margin further from the vertebral spines than on the concave side. At the same time the cavity of the thorax is encroached upon by the bodies of the vertebræ which are rotated towards the ribs. To such an extent does this sometimes take place that the ribs become, as it were, folded round the vertebræ, and in extreme cases may almost touch the anterior surface of the spine.[1]

On the concave side of the curve the ribs are carried forwards and approximated to each other; so that the intercostal spaces are narrowed, the bones are pressed together, and but little expansion of the chest can take place.

Thorax.

Looked at in front, the chest is seen to be flattened on the side corresponding to the convexity of the dorsal curve, an appearance which is exaggerated by the relative rotundity of the opposite side, due to the carrying forwards of the ribs. So that supposing the dorsal curve to have, as is commonly the case, its convexity to the right; then viewed from the front, the right side of the chest will appear flattened, and the left side rounded; while regarded posteriorly there will be a flattening of the left, and a rotundity of the right side (see figs. 27 and 28).

As pointed out by Dr. G. Johnson,[2] these appearances may be mistaken by the incautious for the falling in of the front of the chest, due to tubercular deposit, to chronic pneumonia, or to the shrinking of the side after pleuritic effusion.

Viscera.

It will be obvious that the distortions of the spine, and the consequent alterations in the form of the thoracic and abdominal cavities which have been described in the preceding pages, must be accompanied by corresponding changes in the viscera contained within the thorax and abdomen.

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[1] See a specimen in the museum of St. George's Hospital, ser. v. No. 42.

[2] *Brit. Med. Journ.*, July 6, 1878, p. 4. Dr. Johnson also remarks that the percussion note is altered by the change in the curve of the chest wall, the flattened side giving a denser and louder sound.

The spinal cord and the aorta follow the curves of the spine. The lungs are compressed and their expansion interfered with, and the heart is usually somewhat displaced, by the altered condition of the thoracic walls. The relations of the abdominal viscera are also disturbed to a variable extent, by the depression of the ribs and by the lumbar curve.

But these conditions interfere much less with the performance of the functions of the viscera than might be supposed. As may often be observed, pathological changes which take place slowly are usually but little felt, especially if these changes are chiefly of position; and it is surprising to see, even in severe cases of lateral curvature, how the viscera accommodate themselves to their altered situation, and how slight may be the disturbance of function caused thereby. Increased diaphragmatic action may to some extent supply the want of costal mobility; and the natural variations in the size and position of many of the abdominal viscera, allows a considerable margin for alterations in the shape of the cavity which contains them, without any harmful result.

Effects of lateral curvature.

It is not intended, however, to assert that these distortions are productive of no evil consequences; on the contrary, there can be no doubt that there is usually an embarrassment of respiration, which sometimes attains a serious degree; and it is obvious that so important a function cannot in any way be interfered with, without consequences of more or less gravity. The right side of the heart may become dilated, owing to the pulmonary obstruction; or the left side hypertrophied to meet the impediments to circulation. The inability for active exercise may aggravate the lack of oxygenation, and favour digestive debility ; and thus, and in other obvious ways, the general weakness may be increased.

But we should avoid falling into the error of attributing all the complaints of a delicate girl, to a slight deviation from the natural curves of her spine, or of supposing that these complaints are to be put an end to, by fitting her with a complicated apparatus for spinal support.

In the majority of the slighter cases, the spinal curvature is only a part of a general debility, and the patient's sufferings are often due more to the debility than to the condition of the spine ; and I have frequently observed that when the spinal curvature is due to mechanical causes, such as the shortening of a lower limb from fracture, little or no inconvenience is felt from it.

This observation is, I think, of some importance, because it shows that a moderate degree of lateral curvature is not of itself necessarily attended with any particular suffering ; and that, therefore, when pain does accompany the distortion, something else is needed for its relief than mechanical appliances to the spine.

That slight and early stages of lateral curvature are often attended with considerable pain, I do not in the slightest degree deny ; but I wish to combat the notion that the pain depends upon the mere changes in the relative positions of the vertebræ, the mechanical treatment of which is all that is necessary. That this is not the cause of the pain must, I think, be obvious to anyone who will compare the acute suffering complained of by many delicate girls in whom there is but a slight degree of lateral curvature, with the entire absence of pain seen in the numerous cases of far more pronounced curvature depending upon infantile paralysis, old hip disease, or other causes of shortened lower limbs, wherein advice is almost invariably sought because of the deformity, and not because of any pain which is caused thereby.

Cause of pain.

The cause of the pain then must be sought elsewhere than in the altered position of the bones; and a consideration of the pathology of the deformity will, I believe, show that it depends upon a similar cause to that which gives rise to the pain in flat-foot; that is to say, upon the undue stress thrown upon the ligaments in consequence of the muscular debility; and upon the increased nervous sensibility of the weakened and overstretched muscles.

It must be remembered that the spine is held erect not by its ligaments but by its muscles; the ligaments do but hold the bones together and check undue mobility; wherefore, if the muscles are unequal to supporting the weight thrown upon them, the ligaments suffer for lack of their aid, a stress is thrown upon them for which they are not intended, and pain is the result.

The pain suffered in these cases is chiefly of an aching character, such as is usually produced by the slow stretching of fibrous tissue, and it is felt in the spine itself; but to this is often added the discomfort which may even amount to actual pain, of great muscular fatigue. This sense of fatigue is felt most acutely in the great muscles of the back, but is often also present in the serratus, trapezius, and deltoid muscles. The extreme muscular debility in this class of cases of lateral curvature may easily be demonstrated by directing the patient to raise the arms and hold them above the head; when it will be found that the position cannot be maintained for more than a very short time, the arms speedily become tremulous, and are quickly lowered in spite of any effort to the contrary.

Moreover, it is necessary to bear in mind that the word 'pain' has no constant value; and that the degree of pain in any given case depends, not only upon the potency of its cause, but also upon the sensibility of the sufferer.

Backache.

There is a large class of cases, in which backache and weakness of the spinal muscles are the chief manifestations of the condition which has been so aptly named by Sir James Paget[1] 'neuro-mimesis'; and in which we must beware of allowing the person so affected to slide into a condition of chronic invalidism.

It is also very common to see cases in which such symptoms are the more obvious evidences of over fatigue, and in which a careful examination will reveal other signs of the same evil. This is especially the case with young girls of feeble circulation (evidenced by their cold hands and feet), whose enthusiasm for work is in excess of their physical powers. They rise early, study before breakfast, sit long hours before the piano or easel, or attend long and frequent religious services, retire to rest late, take insufficient or innutritious food, and still further exhaust themselves by irregular and fatiguing exercise undertaken with the idea of 'working off the effect of over-study.' At last comes the break-down; the poor girl, who has been cramming into one day the work of six, and who has been held up by the fond and foolish mother as an example of industry, piety, and intellectual excellence, finds herself exhausted and ill. She cannot sit upright, her back aches terribly, her brain feels weak, and in her depression and anxiety she thinks she has some serious spinal disease.

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[1] See Lecture V. in *Clinical Lectures and Essays*, p. 220.

If her back is now examined, there will probably be found a little lateral curvature; for the fatigued muscles, as I have before pointed out, yield on one side or the other to relieve their fatigue. But such a case is surely not to be looked upon as one of spinal disease, but as one of over-fatigue, the treatment of which is so obvious, that I will content myself with saying only that it should *not* be a ‘spinal instrument.’

Treatment of lateral curvature.

The foregoing considerations concerning the manner in which lateral curvature arises, are almost sufficient to indicate the appropriate treatment.

Those cases in which the curve depends upon a difference in the length of the lower extremities, are easily remediable in their early stages, by supplying the defective length in the limb. Thus a valgus pad, a thick soled boot, or a patten, to bring the limbs to the same length, is often all that is needful.

Or if the tilting of the pelvis is due to the effort to save a painful joint or tender corn, the treatment directed to the joint or corn will at the same time suffice to restore the natural condition of the spine.

For curvature depending upon carrying weights upon the arm or shoulder, as in young nurses, the only remedy is the abandonment of the occupation, and a period of complete rest.

For the large class of curvatures having their origin in muscular debility, the treatment should consist of rest to the fatigued muscles, alternated with moderate exercise, and combined with tonics, such as cod-liver oil and iron, which improve the general nutrition of the body.

Couch.

In these cases, the patient should be kept in the recumbent position on an appropriate couch, which is made to fit the natural spinal curves, and which thus gives complete support to the back. The couch should be fitted with a moveable arm for the book or work, and should be so placed that the light falls upon the work and not upon the eyes of the patient. This position should be maintained during the greater part of the day, and should only be relinquished for the purpose of taking such exercise as is thought desirable, and which would of course vary with the amount of debility.

Exercise.

The exercise is best taken in several short instalments, and should vary in kind. Thus a short walk may be taken in the morning, and a ride or some gymnastics in the afternoon ; but as soon as the exercise is finished the recumbent posture should be resumed. Long standing should be avoided ; the exercise should be of an active kind, and should be prescribed with as much exactness as a dose of medicine.

Gymnastics.

Properly regulated gymnastics are very useful, as by this means various sets of muscles can be exercised in rotation, and with a minimum of fatigue. For it should be remembered that the best mode of promoting the nutrition of muscles is by orderly alternations of use and rest.

All such exercises should be taken as far as possible in the open air ; and the patient should be directed to rest frequently and to take long and deep inspirations, so that the chest may be well filled with fresh air. It is too much forgotten that fresh air is one of the best of tonics ; and for such persons as are obliged to be for a great part of the day at rest, it is especially needful to take pains to ensure them all the fresh air possible. The lack of this is one chief cause of the depression from which they so commonly suffer. Their respiratory muscles partake of the general muscular debility, and it will be observed that their respiration is shallow and feeble; natural concomitants of which are a weak circulation, cold extremities, anæmia, and dyspepsia. It is no unimportant matter therefore to teach such patients the proper exercise of their respiratory apparatus, and to procure for them the efficient ventilation of the rooms they occupy.

Chairs.

Care should be taken that all young people are provided with chairs with suitable backs, in which to pursue their studies; and for those with any tendency to lateral curvature, a reclining chair is desirable. I know of none better than those designed by Mr. Liebreich, from whose pamphlet the following illustrations are copied.

It will be observed that the chair, fig. 30, is curved to suit the natural outline of the spine; and this is essential in all chairs or couches intended to give rest to the muscles of the back. A flat couch is quite inefficient for resting the spine; for as it does not fill the hollow of the back, the weight is not taken off the muscles, and no real support is given.

Pillows.

Mr. Liebreich has therefore invented a pillow rest, the form of which is adapted to the natural spinal curve; its inclination can be easily varied, and it can be placed upon an ordinary couch or mattress.

When complete recumbency is desired, I recommend a simple couch, made of a shape that would correspond to that of Mr. Liebreich's chair if its back were depressed to the level of the seat, and the seat prolonged so as to support the whole length of the legs, with a foot-piece placed transversely at its end.

This fulfils the essential requirements, as well as the elaborate and expensive spinal couches usually made for this purpose, although these have convenient additions of arms, book-rests, &c., which of course add to their comfort.

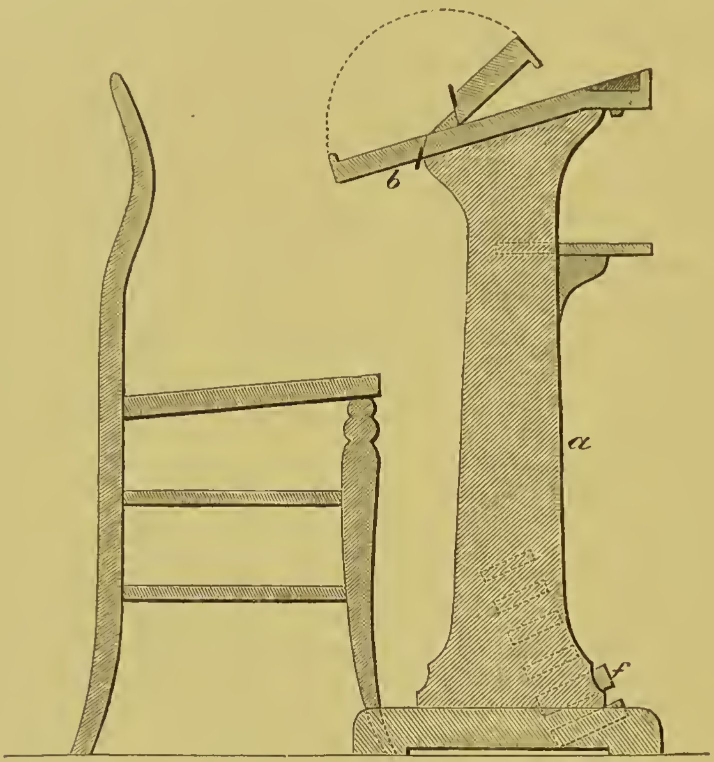

FIG. 29.—DESK AND CHAIR, DESIGNED BY MR. LIEBREICH.

'The desk is the same for boys and girls of different sizes. The proportions of children, or grown-up persons, are adapted to the desk by the use of chairs of different heights, and by the shifting of the footboard *f*. The shape of the back of the chairs is different for the two sexes; the projecting part of it fits into the hollow of the lower part of the spine. The chair must be placed so near the desk that the flap *b*, when turned down, touches the child while it is sitting upright. In order to regulate the height of the chair, it is sufficient to put a rule on the top of the desk, so as to continue its sloping outline towards the elbow of the child. The elbow of the arm which rests on the desk should fall just into the continuation of that sloping outline. If it is higher or lower, a lower or higher chair has to be chosen.'

The flap *b* is arranged so as to bring the edge of the desk near enough to the child to enable the back to rest against the chair when writing; and, by turning up the flap, the inclination proper for writing is changed into the inclination proper for reading. See Liebreich on 'School-Life,' pp. 22 and 23. Churchill, 1878.

Even an ordinary couch or sofa can be made available by placing upon it a pillow to fill the hollow of the loins, and another under the knees to keep the thighs slightly flexed. To be efficient, however, the pillows must be firm and of a proper shape, that for the loins somewhat wedge-shape and thicker at its lower end, that for the knees a double inclined plane.

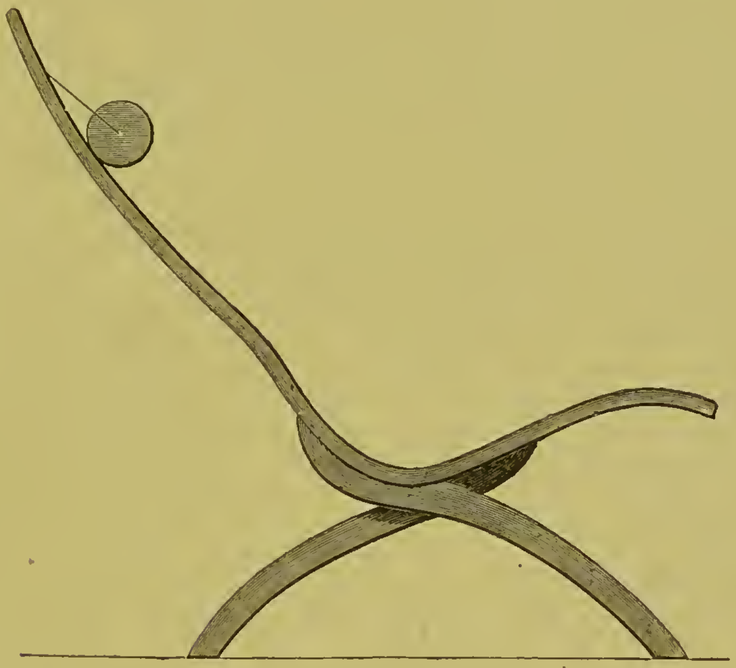

FIG. 30.—RECLINING CHAIR, DESIGNED BY MR. LIEBREICH.

Adapted to the inclination of the body at an angle of 45°. Op. cit., p. 35. The front part of the seat may easily be prolonged into a leg-rest with foot-board.

I have had a pillow made for this purpose, with straps to fix it to the waist and to pass over the shoulders, so as to keep it in position; a small bolster for the head can be attached to the shoulder-straps.

Portable pillows of this kind to a great extent do away with the necessity for special apparatus.

It is probably hardly necessary to point out the absurdity of the old-fashioned practice of making school children stand to say their lessons, and sit upon a backless bench to learn them.

The cold or tepid douche to the back is a valuable aid in the treatment of lateral curvature; sea bathing is usually also beneficial.

Objections to spinal instruments.

It will be observed that I have hitherto said nothing about the use of spinal supports in the treatment of this class of cases; but it is necessary here to mention that numerous ingenious and elaborate instruments have been invented with the object, as is supposed, of supporting and straightening the curved and rotated spine.

These instruments usually consist of (1) a metal band which surrounds the pelvis, (2) to this are fixed lateral crutches which extend to the axillæ, and (3) to the back of the pelvic girdle two levers are attached by a rack and pinion joint, by means of which plates, carried by the upper end of the levers, are made to press upon the ribs.

It is said that by thus pressing upon the ribs, the spinal curves can be unfolded and the distortion cured. The theory is tempting, but I believe erroneous. The problem is not so simple as this method of treatment would imply. In the first place it seems to me impossible so to apply any spinal instrument to the constantly moving ribs, that, in the varying positions of the body, any such pressure can be made upon the ribs as could through their agency rotate the vertebræ. No considerable pressure could indeed be tolerated; for the skin, being pressed between the metal plate of the instrument and the ribs, would soon become sore. Secondly, it must be remembered that the spine does not move as a whole, but by combinations of very slight movements impressed upon the separate vertebræ of which it is composed, by the numerous divisions of the spinal muscles. No machine is capable of adequately imitating the actions of this elaborate muscular apparatus.

Moreover, if the explanation which I have given of the origin of lateral curvature is correct, it must follow that the merely mechanical treatment of the distortion is an error. It is true that in those cases in which the curve depends upon a difference in the length of the lower limbs, it is remedied at once by bringing the limbs to the same level. But in these, the distortion is merely a compensatory adaptation of position, and in no way a spinal disease: the mechanical treatment is applied to the limb, and not to the spine; there can be no question of spinal instruments therefore for these.

So also, in the not uncommon instances in which the curve is produced by carrying a weight on one arm, as in nursing a child, all that is needful is to discontinue the cause and give rest to the fatigued muscles, and the spine assumes its natural condition. There can be no need of spinal instruments for these.

Then lastly, when the curve depends, as in the great majority of cases it does, upon muscular debility; surely such debility is not likely to be lessened by the application of an instrument which, so far as it fulfils its object, prevents the muscles being used.

It may be thought that an instrument, by supporting the spine, would allow the patient to be up, and avoid the necessity for rest in the recumbent position. But it is not so: for no spinal instrument at present invented either ensures complete rest to the spinal muscles, or allows of their proper exercise; and the use of such instruments is consequently followed rather by muscular atrophy than muscular development.

I am quite sure, therefore, that far more harm than good is done by spinal supports in the slighter cases of lateral curvature, in which I would strongly dissuade from their use.

I say this the more decidedly, because the patient or her friends will often beg for such appliances. A delicate girl feels her back weak, and not unnaturally thinks that if she could wear 'a support,' she would feel less fatigue. But no such instrument can be worn without restraining the natural respiratory movements, and interfering with that exercise of the weakened muscles which is the best stimulus to their nutrition. If, therefore, it is not absolutely necessary, a spinal support is doing harm.

Great numbers of growing girls and delicate young women will be found, if examined for the purpose, to have some slight degree of lateral curvature of the spine. The majority of them are not aware of the fact, and it is well for them if they remain in happy ignorance of it. Certainly, because a young lady who is delicate, or over-fatigued, complains of backache, the discovery of a slight degree of lateral deviation of the spine is no good reason for surrounding her with an iron scaffolding.

Such treatment is as unscientific as it would be to apply irons to support the legs of a person recovering from fever, because he is unable to walk steadily.

Cases needing supports.

I admit, nevertheless, that in severe, advanced, and rapidly increasing curvatures, especially in young children, some form of spinal support becomes necessary, and often affords great relief. This should, however, not be looked upon as a substitute for, but as an adjunct to, other treatment; and should be regarded as a necessary evil, to be left off as soon as possible, and in all cases to be removed daily for proper exercise and bathing.

In severe cases of long standing, in which a cure is not to be hoped for, much comfort may often be obtained, and an increase of the deformity prevented, by a well-fitting support, especially if applied after extension of the spine.

Extension of spine.

Dr. Sayre has recently called attention to the advantages of extension by suspension, in the treatment of lateral curvature; and recommends the application of a plaster of Paris jacket, for the maintenance of the extension thus obtained Dr. Sayre's apparatus for extension (which he uses also in the treatment of angular curvature from caries) is certainly most efficient and convenient. It consists of a tripod stand, from which the patient can be suspended by the head and shoulders. Less efficient extension may be made by suspension from a horizontal bar, grasped by the hands, at a sufficient height to prevent the feet touching the ground.

While the spine is in this condition of extension, a support may be moulded to the trunk (a soft jersey intervening between the 'jacket' and the skin), and the improved position then to a great extent maintained.

Spinal splints.

The best material for the jacket or splint with which I am acquainted is that known as the poroplastic felt. Before the invention of this by Mr. Cocking, I was in the habit of having a cast taken of the trunk, to which was moulded a strong leather splint or case; and this I found gave very efficient support: but the poroplastic felt is much more convenient, inasmuch as it can be moulded directly upon the patient, thus saving the trouble of the cast. Moreover, it can be fitted with greater accuracy and facility, and has the advantage of allowing parts to be left soft where desired, so that undue pressure may be avoided. The jacket may be made to lace or buckle, and is thus capable of removal when necessary (see fig. 15, p. 57).

This is in my opinion by far the most efficient kind of spinal support, and is much to be preferred to the heavy and complicated metal instruments hitherto ordinarily employed.

Plaster jacket.

The plaster of Paris jacket introduced by Dr. Sayre may be applied for the same purpose, but I do not now use it, for the following reasons, which I extract from my Report on the Orthopœdic Department of St. George's Hospital, for 1878.

'A. In lateral curvature. 1. Because I believe great benefit to be derived from systematic exercise; and this cannot be properly undertaken without removing the jacket, which cannot conveniently be done if it is of plaster.

'2. The plaster-jacket precludes the use of the cold douche, a most important aid in the treatment.

'3. It interferes with proper ablutions, and thus with the healthy action of the skin.

'B. In angular curvature, the plaster-jacket is inconvenient, because it prevents examination of the back for the detection of abscess or of inflammation of the skin, and also because it interferes with cleanliness.

'Sores may form over the bony prominences without giving any indication by pain or otherwise of their presence; and several instances have occurred at the hospital in which lice have been bred beneath the jacket.

'While admitting, therefore, the great value of Dr. Sayre's method of supporting and fixing the spine by a jacket, it seems to me that the poroplastic felt, and leather, are more appropriate materials for the purpose than plaster of Paris.'[1]

Use of spinal splints.

These jackets are also useful in cases of considerable curvature, in which extension straightens or greatly lessens the curve, but in which the muscles have not the power needful for maintaining the improved position. They may also be used as aids towards the resumption of the upright posture by those who have been undergoing long periods of rest and recumbency.

But I would repeat that neither this, nor any other spinal support, can give the rest to the spinal muscles which is obtained by the recumbent position; and that as weakened muscles cannot gain strength except by their use, it is needful that such supports should be removed daily to allow of systematic exercise.

The jacket will also be found very useful for cases of rapidly increasing curvature in young children, whom it is difficult to keep properly at rest.

In instances in which the distortion is the result of habitually assuming a particular position, the jacket may be advantageously employed as a restraint, and as a means of reminding the patient of the error.

When lateral curvature occurs in cases of wryneck, no time should be lost in the treatment of the primary deformity.[2]

Hysterical curvature.

Occasionally, severe lateral curvature is met with, having its origin in the peculiar nervous condition generally called hysteria. This must be distinguished from ordinary lateral curvature depending upon debility or other causes, and *associated with* hysterical symptoms. Such an association is not uncommon, and the hysteria has no necessary influence upon the deformity, though it often exaggerates its symptoms, as it does those of other diseases. In the true hysterical lateral curvature, the muscles are in a state of spasmodic contraction, which usually comes on suddenly in a person showing no signs of muscular debility, but who probably gives other evidences of the hysterical condition.

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[1] *St. George's Hospital Reports*, vol. ix. p. 616.

[2] See chap. ii. p. 53.

To these it is best to administer an anæsthetic, which abolishes the deformity ; and if the curvature recurs, as it often does, when consciousness is regained, the patient must again take an anæsthetic, and a jacket should be applied while insensibility is still maintained. When the person has been subjected to the restraint of the jacket for a few days, it should be removed, and as little attention as possible bestowed upon the spine. Of course in these cases the condition of the generative system should be enquired into, and suitable constitutional treatment adopted.

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